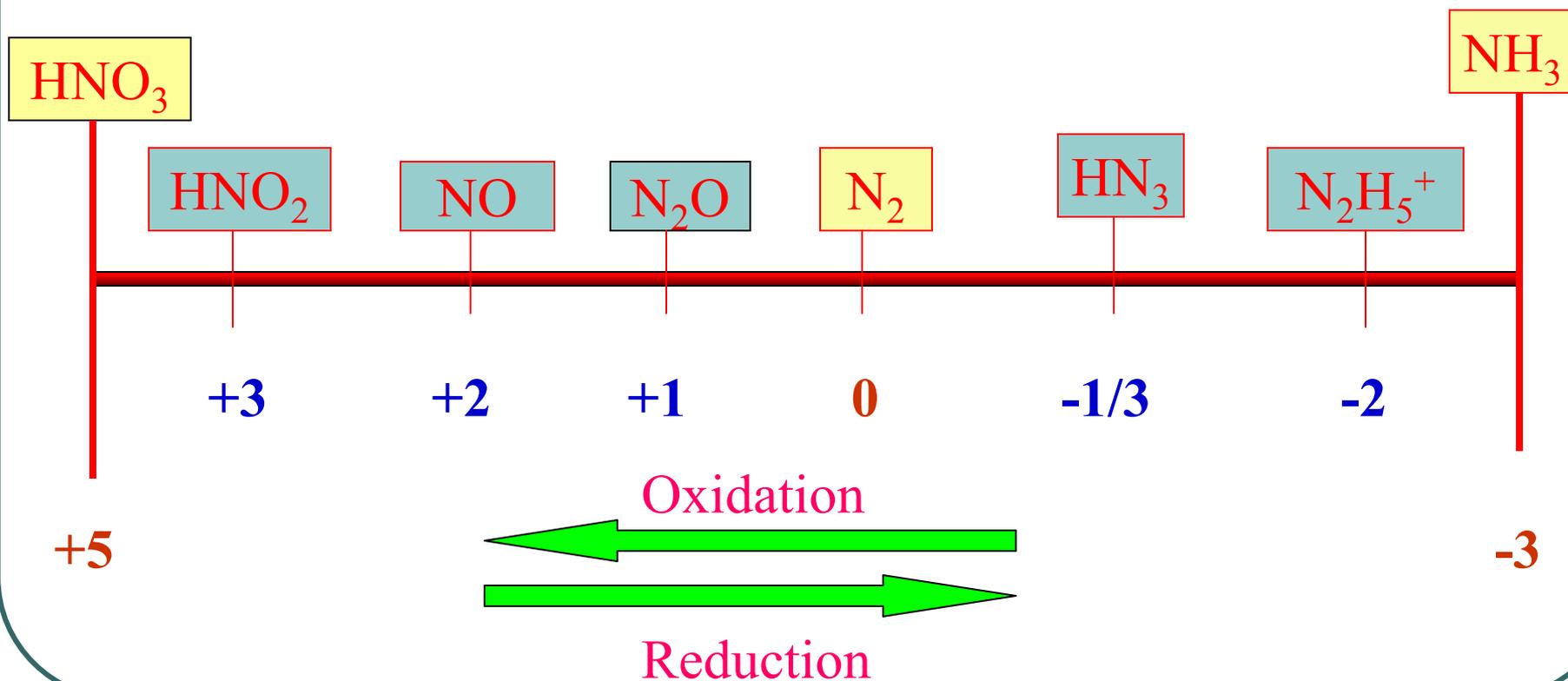
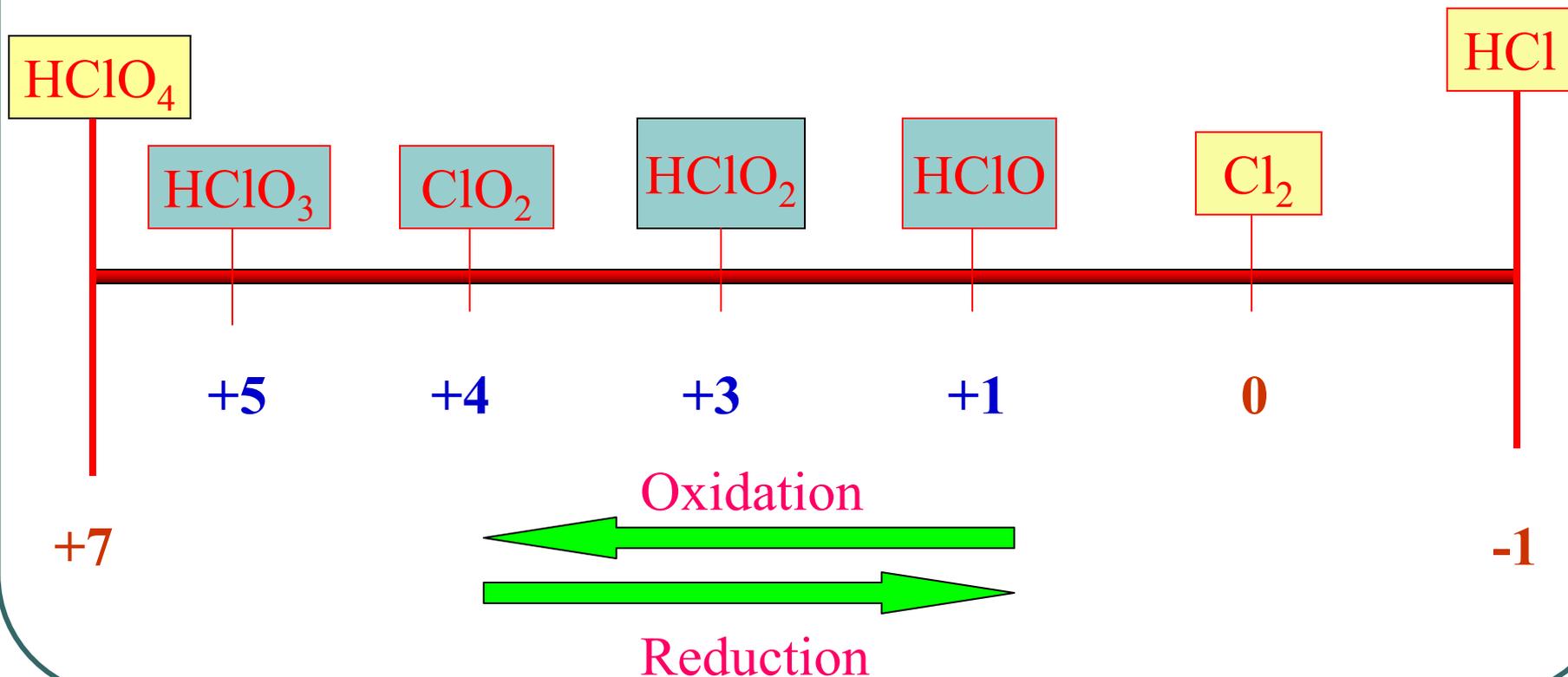


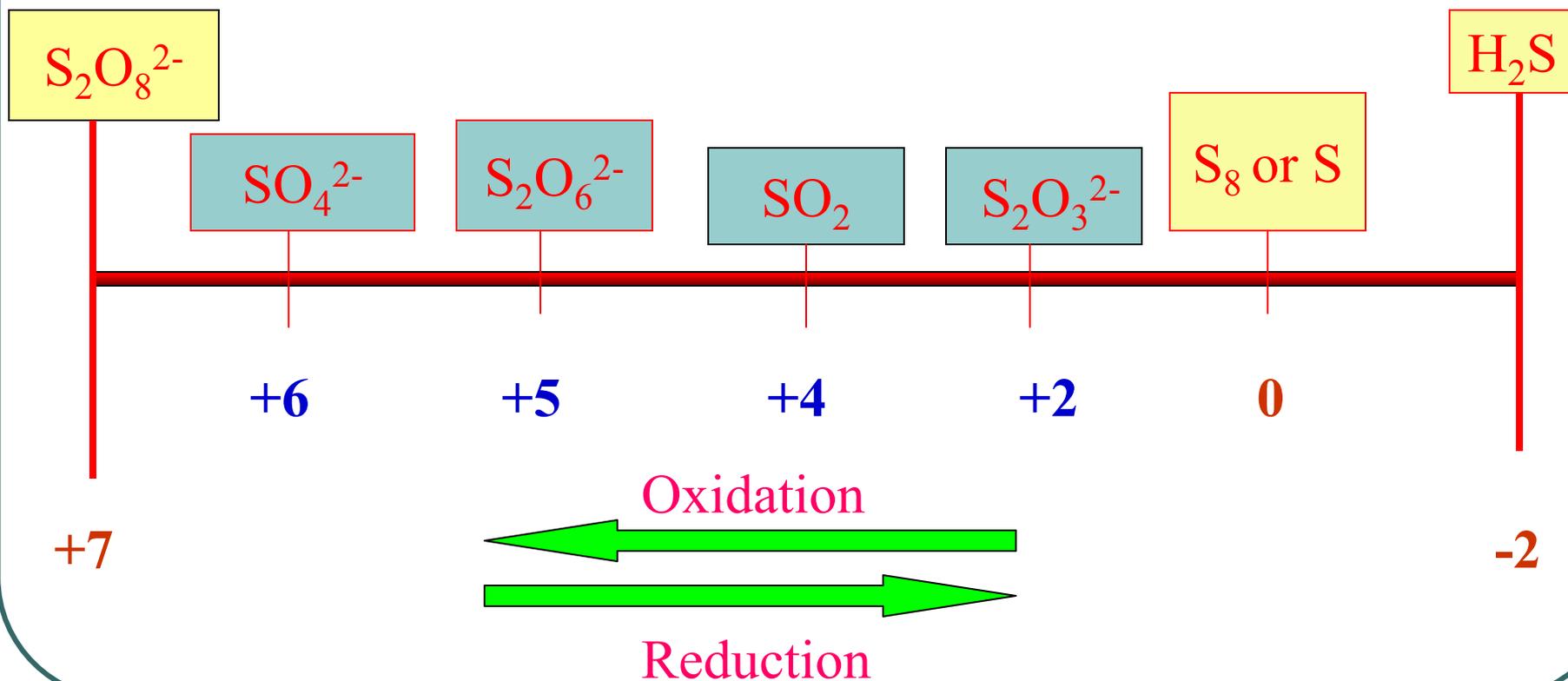
# Oxidation States of Nitrogen



# Oxidation States of Chlorine



# Oxidation States of Sulfur



# Naming Some Inorganic Compounds

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- Binary compounds are made of two elements.
  - metal + nonmetal = ionic compound
  - nonmetal + nonmetal = covalent compound
- Name the **more metallic** element **first**.
  - Use the element's name.
- Name the **less metallic** element **second**.
  - Add the suffix "**ide**" to the element's stem.

## Naming Some Inorganic Compounds

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- $\text{LiBr}$       lithium bromide
- $\text{Li}_2\text{S}$       lithium sulfide
- $\text{Al}_2\text{O}_3$       aluminum oxide
- $\text{Na}_3\text{P}$       sodium phosphide
- $\text{Mg}_3\text{N}_2$       magnesium nitride

# Naming Some Inorganic Compounds

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- Binary ionic compounds containing metals that exhibit more than one oxidation state
- There are two methods to name these compounds.
  1. Older method
    - add suffix “ic” to element’s Latin name for higher oxidation state
    - add suffix “ous” to element’s Latin name for lower oxidation state
  2. Modern method
    - use Roman numerals in parentheses to indicate Transition Metal’s oxidation state

# Naming Some Inorganic Compounds

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<u>Compound</u>	<u>Old System</u>	<u>Modern System</u>
● FeBr <sub>2</sub>	ferrous bromide	iron(II) bromide
● FeBr <sub>3</sub>	ferric bromide	iron(III) bromide
● TiCl <sub>2</sub>	titanous chloride	titanium(II) chloride
● TiCl <sub>3</sub>	titanic chloride	titanium(III) chloride
● TiCl <sub>4</sub>	<u>does not work</u>	titanium(IV) chloride

# Naming Some Inorganic Compounds

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- **Binary Acids** are binary compounds consisting of hydrogen and a nonmetal.
- Compounds are usually **gases** at room temperature and pressure.
  - Nomenclature for the **gaseous** compounds is hydrogen (stem)ide.
- When the compounds are **dissolved in water** they form acidic solutions.
  - Nomenclature for the **acidic solutions** is hydro (stem)ic acid.

# Naming Some Inorganic Compounds

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<u>Formula</u>	<u>Name</u>	<u>Aqueous solution</u>
● HF	hydrogen fluoride	hydrofluoric acid
● HCl	hydrogen chloride	hydrochloric acid
● HBr	hydrogen bromide	hydrobromic acid
● H <sub>2</sub> S	hydrogen sulfide	hydrosulfuric acid

# Naming Some Inorganic Compounds

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- **Binary covalent molecular compounds composed of two nonmetals other than hydrogen**
  - Nomenclature must include prefixes that **specify the number of atoms** of each element in the compound.

<u>Number</u>	<u>Prefix</u>
2	di
3	tri
4	tetra
5	penta
6	hexa
7	hepta
8	octa
9	nona
10	deca

# Naming Some Inorganic Compounds

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<u>Formula</u>	<u>Name</u>
● CO	<del>(mono)</del> carbon monoxide
● CO <sub>2</sub>	carbon dioxide
● SO <sub>3</sub>	sulfur trioxide
● OF <sub>2</sub>	oxygen difluoride
● P <sub>4</sub> O <sub>6</sub>	tetraphosphorus hexoxide

# Naming Some Inorganic Compounds

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<u>Formula</u>	<u>Old Name</u>	<u>Modern Name</u>
● $N_2O$	nitrous oxide	dinitrogen monoxide
● $NO$	nitric oxide	nitrogen monoxide
● $N_2O_3$	nitrogen trioxide	dinitrogen trioxide
● $NO_2$	nitrogen dioxide	nitrogen dioxide
● $N_2O_4$	nitrogen tetroxide	dinitrogen tetroxide
● $N_2O_5$	nitrogen pentoxide	dinitrogen pentoxide

# Naming Some Inorganic Compounds

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- **Ternary Acids and Their Salts** are made of three elements.
  - The elements are H, O & a nonmetal.
- Two of the compounds are chosen as the basis for the nomenclature system.
  - Higher oxidation state for nonmetal is named (stem)ic acid.
  - Lower oxidation state for nonmetal is named (stem)ous acid
- Salts are named based on the acids.
  - Anions of **-ic** acids make **“ate”** salts.
  - Anions of **-ous** acids make **“ite”** salts.

**TABLE 4-12** *Formulas of Some “-ic” Acids*

Periodic Group of Central Elements				
<i>IIA</i>	<i>IVA</i>	<i>VA</i>	<i>VIA</i>	<i>VIIA</i>
$\overset{+3}{\text{H}_3\text{BO}_3}$ boric acid	$\overset{+4}{\text{H}_2\text{CO}_3}$ carbonic acid	$\overset{+5}{\text{HNO}_3}$ nitric acid		
	$\overset{+4}{\text{H}_4\text{SiO}_4}$ silicic acid	$\overset{+5}{\text{H}_3\text{PO}_4}$ phosphoric acid	$\overset{+6}{\text{H}_2\text{SO}_4}$ sulfuric acid	$\overset{+5}{\text{HClO}_3}$ chloric acid
		$\overset{+5}{\text{H}_3\text{AsO}_4}$ arsenic acid	$\overset{+6}{\text{H}_2\text{SeO}_4}$ selenic acid	$\overset{+5}{\text{HBrO}_3}$ bromic acid
			$\overset{+6}{\text{H}_6\text{TeO}_6}$ telluric acid	$\overset{+5}{\text{HIO}_3}$ iodic acid

# Naming Some Inorganic Compounds

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## Name

carbonic acid

nitric acid

boric acid

phosphoric acid

sulfuric acid

chloric acid

bromic acid

iodic acid

silicic acid

## Formula



# Naming Some Inorganic Compounds

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- Salts are formed by the reaction of the acid with a strong base.

- Acid



- Salt



# Naming Some Inorganic Compounds

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- Acids that have a **higher oxidation state than the “ic” acid** are given the prefix **“per”**.
  - These acids and salts will have one more O atom than the “ic” acid.
- Acids that have a **lower oxidation state than the “ous” acid** are given the prefix **“hypo”**.
  - These acids and salts will have one less O atom than the “ic” acid.

Decreasing  
oxidation number  
of central atom  
↓

### Ternary Acid

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*perXXXic acid*

*XXXic acid*

*XXXous acid*

*hypoXXXous acid*

### Anion

---

*perXXXate*

*XXXate*

*XXXite*

*hypoXXXite*

Decreasing number  
of oxygen atoms  
on central atom  
↓

# Naming Some Inorganic Compounds

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- Acid



hypochlorous acid



chlorous acid



chloric acid



perchloric acid

- Na Salt



sodium hypochlorite



sodium chlorite



sodium chlorate



sodium perchlorate

# Naming Some Inorganic Compounds

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- **Acidic Salts** are made from ternary acids that retain one or more of their acidic hydrogen atoms.
  - Made from acid base reactions where there is an insufficient amount of base to react with all of the hydrogen atoms.
- Old system used the prefix “**bi**” to denote the hydrogen atom.
- Modern system uses **prefixes** and the word **hydrogen**.

# Naming Some Inorganic Compounds

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- $\text{NaHCO}_3$   
Old system sodium bicarbonate  
Modern system sodium hydrogen carbonate
- $\text{KHSO}_4$   
Old system potassium bisulfate  
Modern system potassium hydrogen sulfate
- $\text{KH}_2\text{PO}_4$   
Old system potassium *bis* biphosphate  
Modern system potassium dihydrogen phosphate
- $\text{K}_2\text{HPO}_4$   
Old system potassium biphosphate  
Modern system potassium hydrogen phosphate

**Q59, P 168. Write formulas for the compounds that are expected to be formed by the following pairs of ions:**

	A. $\text{Cl}^-$	B. $\text{OH}^-$	C. $\text{SO}_4^{2-}$	D. $\text{PO}_4^{3-}$	E. $\text{NO}_3^-$
1. $\text{NH}_4^+$		Omit – see note			
2. $\text{Na}^+$					
3. $\text{Mg}^{2+}$					
4. $\text{Ni}^{2+}$					
5. $\text{Fe}^{3+}$					
6. $\text{Ag}^+$					

**Chemistry is Fun!**