

# CHEMISTRY FOR ENGINEERS

## ASSIGNMENT 2

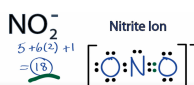
Date : 10/1/2023

Duration : 1 week, 17/1/2023

### Part I: MULTIPLE CHOICE QUESTIONS (5pts)

1. The octet rule states that:

- a. Elements become stable by having 8 electrons
- b. Elements become stable by having 8 valence electrons**
- c. Same number of protons and electrons
- d. Conserving electrons



2. Choose the species that is **incorrectly** matched with the **electronic** geometry about the central atom.

- a.  $\text{NO}_2^-$  - trigonal planar **bent**
- c.  $\text{SO}_3^{2-}$  - pyramidal **tetrahedral**

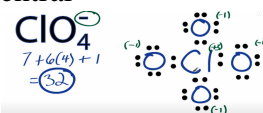
**correct**



--> Molecular Geometry

- b.  $\text{ClO}_4^-$  - tetrahedral **correct**
- d.  $\text{ClO}_3^-$  - tetrahedral**

cau nay chac sai



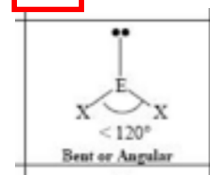
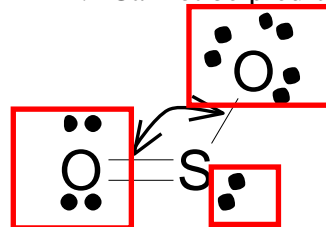
3. In an actual  $\text{SO}_2$  molecule, the indicated angle would best be described as...

- A. Greater than  $90^\circ$
- B. Equal to  $90^\circ$
- C. Less than  $90^\circ$
- D. Greater than  $109\frac{1}{2}^\circ$
- E. Equal to  $109\frac{1}{2}^\circ$
- F. Less than  $109\frac{1}{2}^\circ$
- G. Greater than  $120^\circ$
- H. Equal to  $120^\circ$
- I. Less than  $120^\circ$**
- J. Greater than  $180^\circ$
- K. Equal to  $180^\circ$
- L. Less than  $180^\circ$

Sulfur Dioxide



M. Cannot be predicted



4. **Covalent compounds** are formed by:

- a. Transfer of electrons
- c. Losing electrons

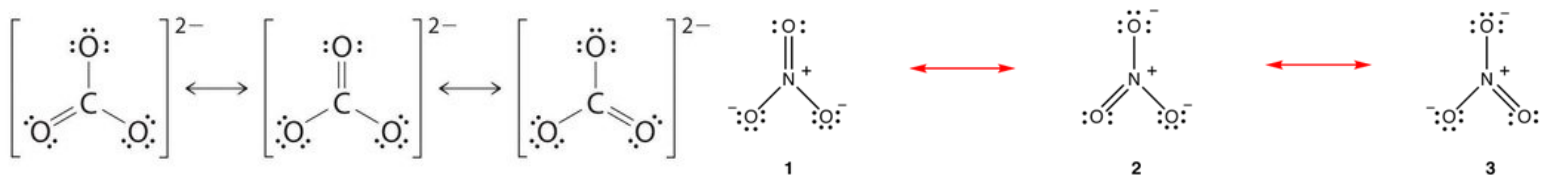
- b. Gaining electrons
- d. Sharing electrons**

5. Why do elements **form compounds**?

- a. To form new compounds
- c. To become unstable

- b. To become stable like the noble gases**
- d. To give away electrons

Steric No.	Basic Geometry 0 lone pair	VSEPR Geometries			
		1 lone pair	2 lone pairs	3 lone pairs	4 lone pairs
2	Linear $180^\circ$				
3	Trigonal Planar $120^\circ$	Bent or Angular $< 120^\circ$			
4	Tetrahedral $109^\circ$	Trigonal Pyramidal $< 109^\circ$	Bent or Angular $< 109^\circ$		
5	Trigonal Bipyramidal $120^\circ$	Square Planar $90^\circ$	T-shaped $< 90^\circ$	Linear $180^\circ$	
6	Octahedral $90^\circ$	Square Pyramidal $< 90^\circ$	Square Planar $90^\circ$	T-shaped $< 90^\circ$	Linear $180^\circ$



## Part II: CONSTRUCTED QUESTIONS (95pts)

$$0.3 < x < 1.7$$

x in left --> nonpolar covalent  
x in middle --> polar covalent  
x in right --> ionic

? 1. Draw the three resonance structures of carbonate ion,  $\text{CO}_3^{2-}$ . (6pts)

? 2. Draw the three resonance structures of nitrate ion,  $\text{NO}_3^-$ . (6pts)

3. Use electronegativities to determine whether the bonds in the following compounds are **ionic**

**or covalent**. Show your reasoning. (12pts)

Electronegativities: Ca, 1.3; O, 3.4; C, 2.6; Na, 0.9; Mg, 1.3; S, 2.6; I, 2.7; N, 3.0; Br, 3.0.

Formal Charge	=	Valence Electrons	-	Nonbonding Val Electrons	-	Bonding Electrons	/2	=
C	=	4	-	0	-	8/2	=	0
O	=	6	-	6	-	2/2	=	-1
O	=	6	-	4	-	4/2	=	0

$$3.4 - 2.6 = 0.8$$

$$2.7 - 1.3 = 1.4$$

a.  $\text{CO}_2$  Since  $0.3 < 0.8 < 1.7$ , the bond is **polar covalent**.

b.  $\text{CaO}$   $3.4 - 1.3 = 2.1$

Since  $2.1 > 1.7$ , the bond is **ionic**.

c.  $\text{NaBr}$   $3.0 - 0.9 = 2.1$

Since  $2.1 > 1.7$ , the bond is **ionic**.

d.  $\text{MgI}$  Since  $0.3 < 1.4 < 1.7$ , the bond is **polar covalent**.

e.  $\text{SO}_2$   $3.4 - 2.6 = 0.8$

Since  $0.3 < 0.8 < 1.7$ , the bond is **polar covalent**.

f.  $\text{NI}_3$   $3.0 - 2.7 = 0.3$

Since  $0.3 < 1.7$ , the bond is **nonpolar covalent**.

4. Draw the Lewis structures of the following molecules; name the **shape** of the molecule (not the electron arrangement); state whether the molecule is **polar** or **non-polar** by using dipole moment and determine **idealize bond angle** of the molecule. **Resonance structures may be ignored**. (36pts)

a.  $\text{H-C}\equiv\text{C-H}$   
Shape of molecule: Linear  
Idealize bond angle:  $180^\circ$   
The molecule is nonpolar since the dipole moment is cancel each other.

a.  $\text{HCCH}$

b.  $\text{PF}_3$

Shape of molecule: Trigonal Planar

c.  $\text{IF}_5$

Idealize bond angle:  $120^\circ$

The molecule is polar since the dipole moment is not equal zero.

d.  $\text{Cl}_2\text{CO}$  (C is center atom)

Shape of molecule: trigonal pyramidal

Idealize bond angle:  $< 109.5^\circ$

The molecule is polar since the dipole moment is not equal zero.

e.  $\text{SiH}_2\text{Cl}_2$  (Si is center atom)

f.  $\text{SCN}^-$  (C is center atom)

g.  $\text{AlCl}_3$

h.  $\text{H}_2\text{O}$

Shape of molecule: Trigonal Planar

Idealize bond angle:  $120^\circ$

The molecule is nonpolar since the dipole moment is cancel each other.

Shape of molecule: Tetrahedral  
Idealize bond angle:  $109.5^\circ$   
The molecule is polar since the dipole moment is not equal zero.

Shape of molecule: linear  
Idealize bond angle:  $180^\circ$   
The molecule is polar since the dipole moment is not equal zero. The dipole moment between S and C is greater than between N and C since electronegativity of S is larger than N.

Shape of molecule: bent  
Idealize bond angle:  $109.5^\circ$   
The molecule is polar since the dipole moment is not equal zero.

**INTRA-MOLECULAR FORCES**  
Bonding Forces  
Exist WITHIN Molecules

**INTER-MOLECULAR FORCES**  
Attractive Forces  
Non-bonding Forces  
Exist BETWEEN Molecules

**Determine Chemical Properties...**  
Ionic Bond  
Covalent Bond  
Metallic Bond

**Determine Physical Properties...**  
Dipole Dipole Forces  
Hydrogen Bonding  
London Dispersion Forces

? 5. Show your understand about **intermolecular forces** and **intramolecular forces**? How many **type** of intermolecular forces are there? **Definition** of each types? Give **example** with explanations (at least 3 compounds for each type)? Arrange them from the weakness to strongest. (25pts)

? 6. **Lee Jong-suk**, a first year student who failed Chemistry for Engineering course, is a terrible nightmare with lecture 7: Intermolecular Forces. Students! By using knowledge learnt please answer this question to help Lee come over lecture 7. The question is **intermolecular forces affect the melting and boiling points of the compound**? (10pts)

intermolecular forces **increase the bonding strength** between two or more molecules. In general, as intermolecular force strength increases, the melting and boiling points of a substance also increase.

**Good luck!!!**

## ❖ NOTE FOR DRAWING LEWIS AND RESONANCE STRUCTURES:

- \_ Show each **bonding** pair of electrons as a **line** (—)
- \_ Show **non-bonding** valence electrons as **dots** (:).
- \_ Get Opt for missing any electron in compound or mistake from drawing compound.