

## Announcements – Lecture XV – Wednesday, June 11<sup>th</sup>

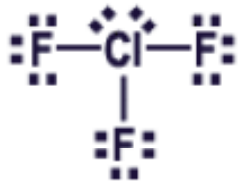

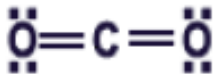

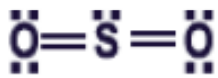

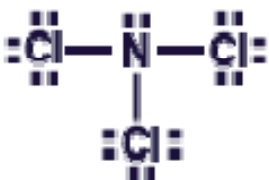
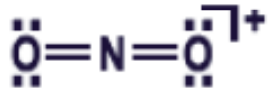
1. Exam II: **Friday, June 13<sup>th</sup>, In Class**
2. Fifth Lab: **Tuesday, June 17<sup>th</sup>, ISB 155 (A-C)**



# Quiz 12

Class #: \_\_\_\_\_

Last Name: \_\_\_\_\_

|   |   |   |   |
|---|---|---|---|
| <p>A</p>                       | <p>B</p>                       | <p>C <math>AX_2E_0</math></p>  | <p>D</p>                       |
| <p>E <math>AX_2E_1</math></p>  | <p>F <math>AX_3E_0</math></p>  | <p>G <math>AX_3E_1</math></p>  | <p>H <math>AX_2E_0</math></p>  |

1. The **Electron Pair Geometry** of C:

LINEAR

2. The **Molecular Geometry** of G:

TRIGONAL PYRAMID

3. The **Bond Angle** around S in E:

$\sim 120^\circ$

4. The **molecule(s)** with a bond angle of  $180^\circ$ :

C, D, H


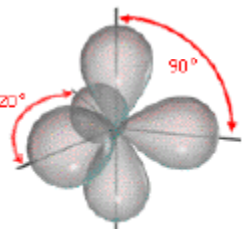

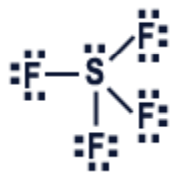
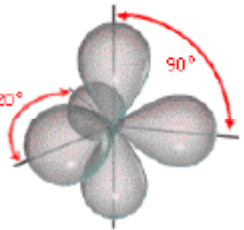

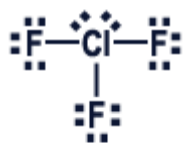
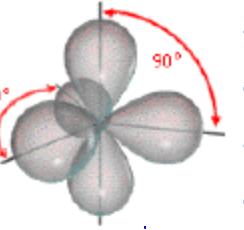
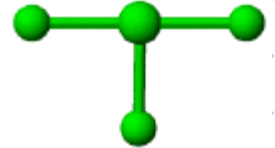


# 8.5 Valence-Shell Electron-Pair Repulsion and Molecular Shape

## B: Electron Pair Geometries – Molecular Geometries

### Trigonal Bipyramid

$$X+E=5$$

| Lewis Structure   | Class                   | Electron Pair Geometry  | Molecular Geometry  | Bond Angles          |
|---|-------------------------|---|---|----------------------|
| $\text{PF}_5$<br>    | $\text{AX}_5\text{E}_0$ |  <p>TRIGONAL BIPYRAMID</p>   |  <p>TRIGONAL BIPYRAMID</p> | $120^\circ/90^\circ$ |
| $\text{SF}_4$<br>   | $\text{AX}_4\text{E}_1$ |  <p>TRIGONAL BIPYRAMID</p>  |  <p>SEESAW</p>             | $120^\circ/90^\circ$ |
| $\text{ClF}_3$<br> | $\text{AX}_3\text{E}_2$ |  <p>TRIGONAL BIPYRAMID</p> |  <p>T-SHAPED</p>         | $90^\circ$           |


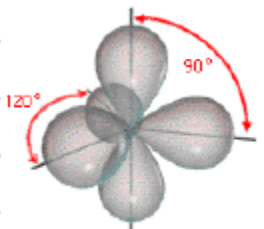



## 8.5 Valence-Shell Electron-Pair Repulsion and Molecular Shape

### B: Electron Pair Geometries – Molecular Geometries

#### Trigonal Bipyramid

$$X + E = 5$$

| Lewis Structure   | Class                   | Electron Pair Geometry  | Molecular Geometry  | Bond Angles |
|---|-------------------------|---|---|-------------|
| $\text{XeF}_2$<br> | $\text{AX}_2\text{E}_3$ | <br>TRIGONAL BIPYRAMID | <br>LINEAR | $180^\circ$ |


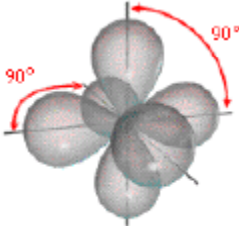
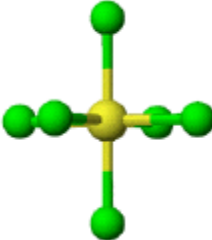

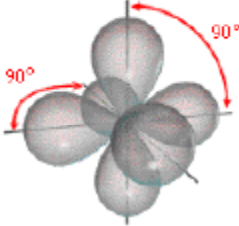
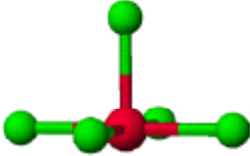

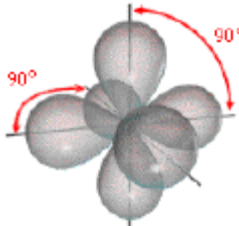



## 8.5 Valence-Shell Electron-Pair Repulsion and Molecular Shape

### B: Electron Pair Geometries – Molecular Geometries

#### Octahedron

$$X+E=6$$

| Lewis Structure   | Class                   | Electron Pair Geometry  | Molecular Geometry   | Bond Angles |
|---|-------------------------|---|--|-------------|
| $\text{SF}_6$<br>    | $\text{AX}_6\text{E}_0$ | <br>OCTAHEDRON   | <br>OCTAHEDRON      | $90^\circ$  |
| $\text{BrF}_5$<br>  | $\text{AX}_5\text{E}_1$ | <br>OCTAHEDRON  | <br>SQUARE PYRAMID  | $90^\circ$  |
| $\text{XeF}_4$<br> | $\text{AX}_4\text{E}_2$ | <br>OCTAHEDRON | <br>SQUARE PLANAR | $90^\circ$  |



## 8.5 Valence-Shell Electron-Pair Repulsion and Molecular Shape

### B: Electron Pair Geometries – Molecular Geometries

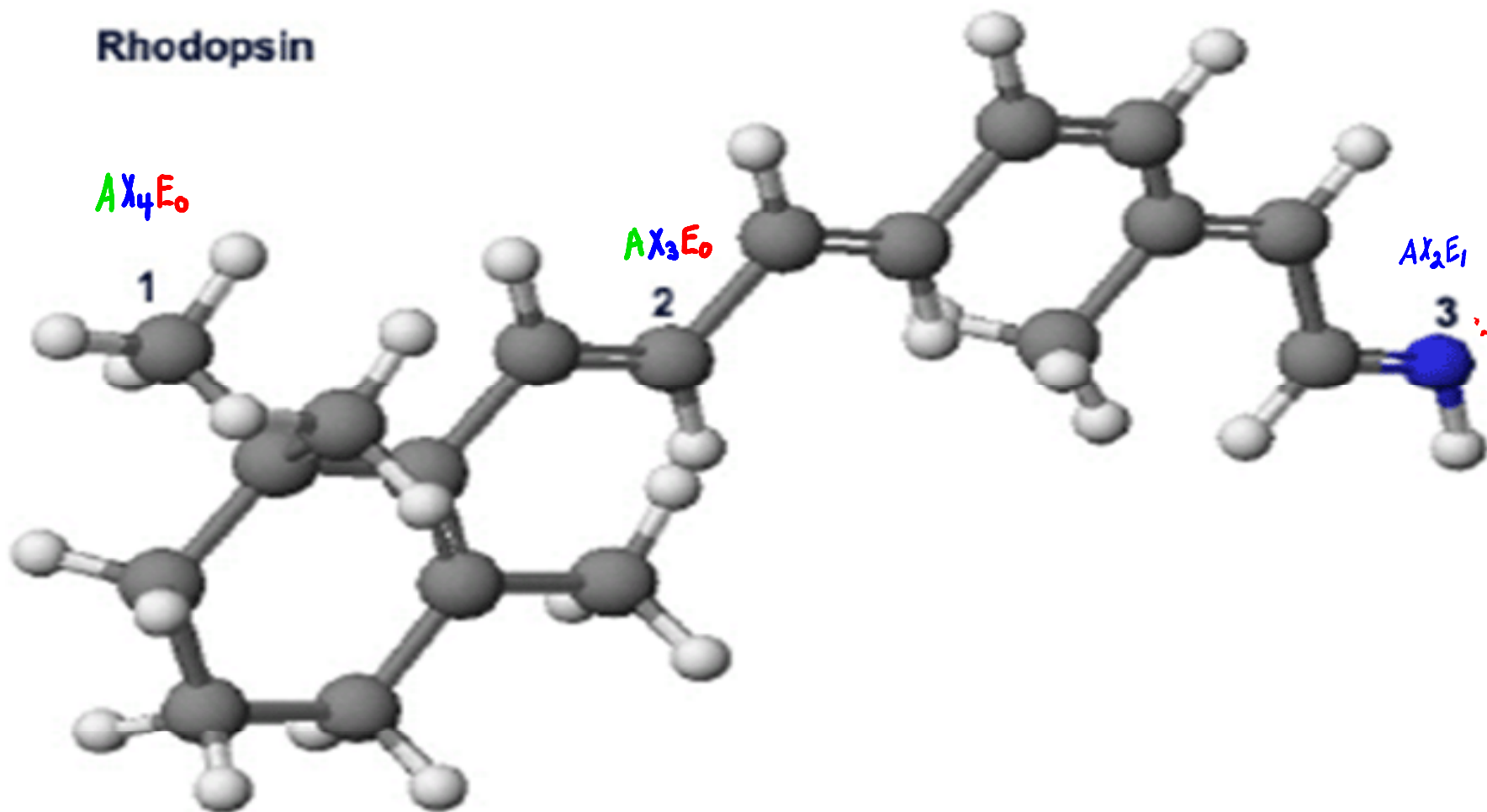
#### Summary

| X+E | Electron Pair Geometry<br>(Parent) | Molecular Geometry<br>(Offspring)  |
|-----|------------------------------------|--|
| 3   | TRIGONAL PLANAR                    | <ul style="list-style-type: none"> <li>E<sub>0</sub>: TRIGONAL PLANAR</li> <li>E<sub>1</sub>: ANGULAR/BENT (120°)</li> </ul>   |
| 4   | TETRAHEDRON                        | <ul style="list-style-type: none"> <li>E<sub>0</sub>: TETRAHEDRON</li> <li>E<sub>1</sub>: TRIGONAL PYRAMID</li> <li>E<sub>2</sub>: ANGULAR/BENT (109°)</li> </ul>                  |
| 5   | TRIGONAL BIPYRAMID                 | <ul style="list-style-type: none"> <li>E<sub>0</sub>: TRIGONAL BIPYRAMID</li> <li>E<sub>1</sub>: SEESAW</li> <li>E<sub>2</sub>: T-SHAPED</li> <li>E<sub>3</sub>: LINEAR</li> </ul> |
| 6   | OCTAHEDRON                         | <ul style="list-style-type: none"> <li>E<sub>0</sub>: OCTAHEDRON</li> <li>E<sub>1</sub>: SQUARE PYRAMID</li> <li>E<sub>2</sub>: SQUARE PLANAR</li> </ul>                           |

## 8.5 Valence-Shell Electron-Pair Repulsion and Molecular Shape

### Bond Angles in Organic Molecules

Rhodopsin



C-1: ~109°

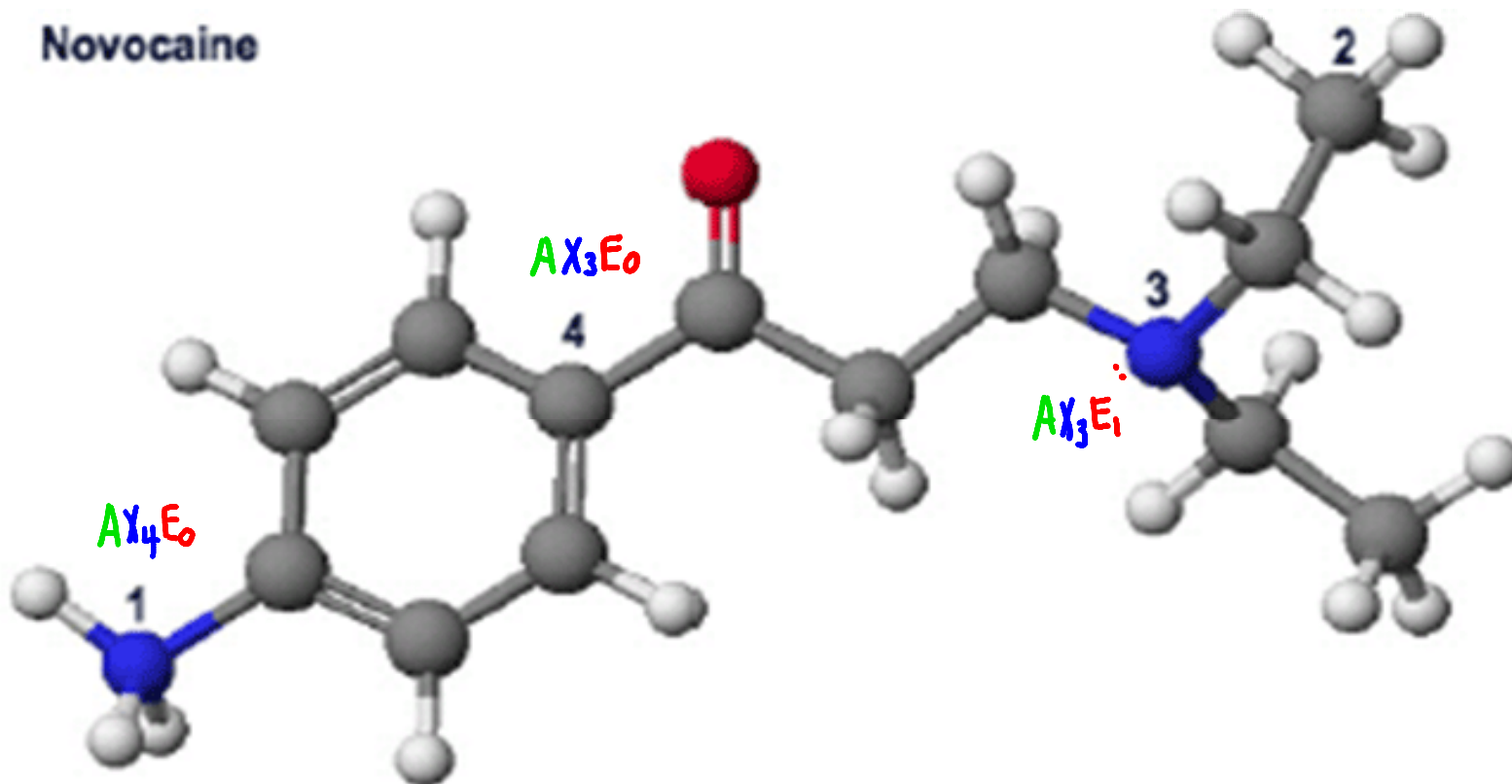
C-2: 120°

N-3: 120°



## 8.5 Valence-Shell Electron-Pair Repulsion and Molecular Shape Bond Angles in Organic Molecules

Novocaine



N-1:  $\sim 109^\circ$

N-3:  $\sim 109^\circ$

C-4:  $120^\circ$





## 8.5 Valence-Shell Electron-Pair Repulsion and Molecular Shape Bond Angles

Which of the following molecules has the smallest bond angle?

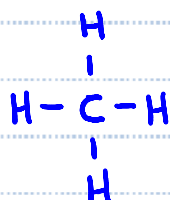
a)  $\text{CH}_4$

b)  $\text{NO}_2^+$

c)  $\text{NH}_3$

d)  $\text{H}_2\text{O}$

$\text{CH}_4$ :



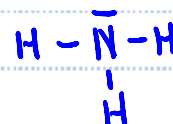
$\text{AX}_4\text{E}_0$

TETRAHEDRON

TETRAHEDRON

$\sim 109^\circ$

$\text{NH}_3$ :



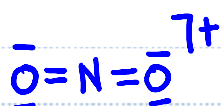
$\text{AX}_3\text{E}_1$

TETRAHEDRON

TRIGONAL PYRAMID

$\sim 109^\circ$

$\text{NO}_2^+$ :



$\text{AX}_2\text{E}_0$

LINEAR

LINEAR

$180^\circ$

$\text{H}_2\text{O}$ :



$\text{AX}_2\text{E}_2$

TETRAHEDRON

ANGULAR / BENT

$\sim 109^\circ$

$\text{H}_2\text{O}$ ! ... lone pair electrons have a larger spatial requirement, the more lone pairs the smaller the bond angle.