T29 Molecular Models and Crystalline Structures

Collect:

- One box of molecular model set (check numbers of beads)
  - 14 black beads
  - 6 red beads
  - 6 green beads
  - Blue tack
  - 16 white beads
  - 6 blue beads
  - 8 other beads

Prepare:

- Digital Camera
- USB driver
- Colored paper

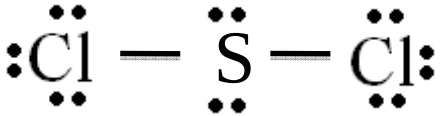
(2011/12/23 revised)

Objective

- To use handcraft candy beads and blue tack to construct molecular models and crystal structures
- To understand the three-dimensional structures of substances

Introduction

- Predict the shape of the molecules
  - Draw the Lewis electron-dot structure
  - Apply **V**alence **S**hell **E**lectron **P**air **R**epulsion, VSEPR, theory
  - Predict the shape of molecule, construct molecular model with beads
  - Understand the three-dimensional structure, bond angle, and polarity of molecule

SCl_2 →  →

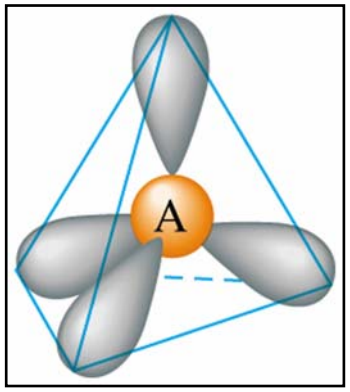
SCl_2

•Sum the valence electrons
•Connect the atoms with single bond
•Full-fill octet rule of outer atoms
•Set remaining electrons on central atom
•Central atom should follow octet rule
•Try multiple bond if electrons are not enough

- **Electrons should be placed with least repulsion**
- **Predict the shape of electron pairs**
- **Predicts the shape of the bonded atoms**
- **Predict the polarity of molecule according the shape of the molecule and the polarity of bonds**

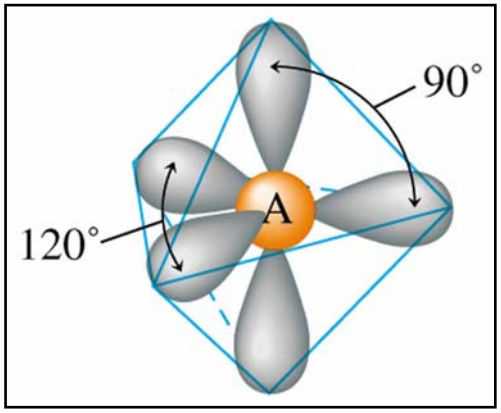
Examples

- 4 electron pairs (tetrahedral)



SO_4^{2-}

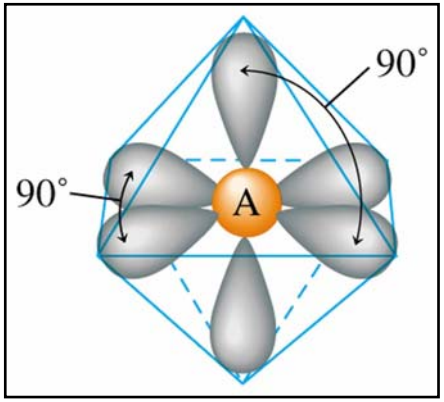
- 5 electron pairs (trigonal bipyramidal)

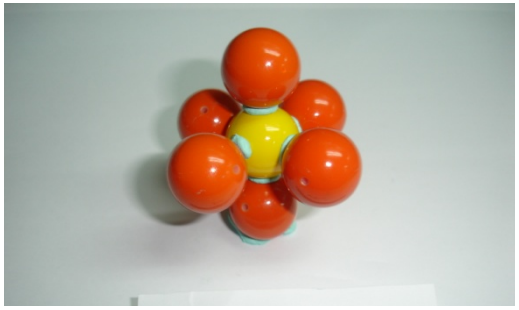


PF_5

Examples

- 6 electron pairs (octahedral)





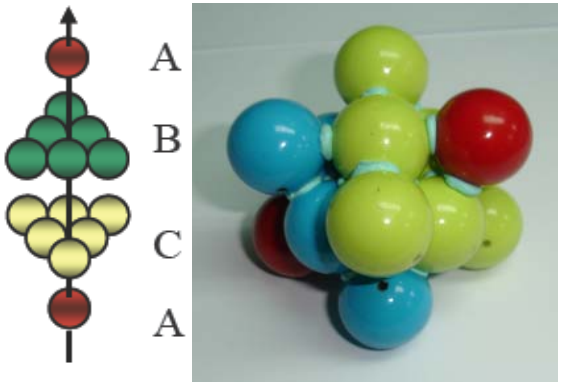
SF_6

Reference: Zumdahl, S. S. *CHEMICAL PRINCIPLES,* 5th Ed.; Houghton Mifflin Co.: Boston, 2005.

Crystalline Structure

- Crystalline structure
  - In a crystalline solid, the atoms, ions, or molecules are arranged orderly in space.
  - Crystalline structure may affect the melting point, density, and malleability
  - Observe the shape of the structures and packing efficiency by constructing the crystalline structures

Body-centered cubic



Cubic **c**lose-**p**acked
(**F**ace-**c**entered **c**ubic)

Tetrahedral hole

Outline of Procedures

(I) Molecular shape

Check the number of beads in the box

↓

Complete table 29-1 to predict the shapes of molecules

↓

Construct the beaded-models. Record with photo

(II) Crystalline Structure

Construct the crystalline structure according to table 29-2 and fig. 29-3

↓

Record with photo

↓

Tidy the model set