

Review of Ch. 3 Understanding Chemical

Compounds

* **Lewis Formulas** can be used to show the number of valence electrons in the outer energy level of an atom. The four orbitals in the outer energy level can be empty, occupied by a single bonding electron or filled with two electrons to make a lone pair.

1. *Draw a Lewis formula of a nitrogen atom and state the number of bonding electrons and lone pairs.*

* **Ionic Bonds** are formed when one or more valence electrons are completely transferred from a metal atom to a non-metal atom thereby filling each atom’s outer energy level (full octet) and producing a positive **cation** and a negative **anion**.

**Covalent Bonds** are formed when one or more valence electrons are shared between non-metal atoms as a way of filling each atom’s outer energy level.

2. *Draw an electron energy level diagram of an aluminium ion.*

3. *Draw Lewis formulas for N2(g) and NaCl(s).*

* **Structural Diagrams** of molecules ignore lone pairs around each atom and represent each shared pair between atoms with a single line.

4. *Draw a Lewis formula and a structural diagram for C2H4.*

5. *Draw a Lewis formula and a structural diagram for IO3−.*

* **VSEPR Theory** can be used to determine the shape(s) of a molecule that minimize the repulsive forces of electrons around each atom. Common types of stereochemistry include:

i) **Linear** (AX2) ii) **Angular** (AX2E2 or AX2E) iii) **Trigonal Planar** (AX3)

 iv) **Pyramidal** (AX3E) v) **Tetrahedral** (AX4)

6. *Draw a stereochemical formula for PF3 and name the shape around phosphorus atom.*

7. *Draw a stereochemical formula for NO2−and name the shape around nitrogen atom.*

* Differences in **electronegativities** of atoms can be used to predict the formation of ionic bonds, polar covalent bonds or non-polar covalent bonds.



8. *List and order the bonds in the following substances according to increasing bond polarity.*

H2O(l), H2(g), CH4(g), HFg, NH3(g), LiH(s), BeH2(s)

* **Bond Dipoles** represent the slight positive end (δ+) and slight negative end (δ−) of a polar covalent bond. When all the bond dipoles of a molecule balance one another, a nonpolar substance results while a polar substance results when the bond dipoles add together.

9. *Use a stereochemical formula with bond dipoles to predict the polarity of the following:*

 a) carbon disulfide, CS2(l) b) oxygen difluoride, OF2(g)

* **Polarity** of molecules can also be predicted using the generalizations shown below.

|  |  |  |
| --- | --- | --- |
|  | Type | Description of molecule |
| Polar | AB | diatomic with different atoms |
| N*x*A*y* | containing nitrogen and other atoms |
| O*x*A*y* | containing oxygen and other atoms |
| C*x*A*y*B*z* | containing carbon and two other kinds of atoms |
| Nonpolar | A*x* | all elements |
| C*x*A*y* | containing carbon and only one other kind of atom (except CO(g)) |

10. *Predict the polarity of the following molecules:*

a) CHFCl2(g) b) C2H4(g) c) NH3(g) d) Cl2(g)

* **Intramolecular Forces** include the strong ionic bonds and covalent bonds holding atoms or ions together inside a molecule or formula unit.

**Intermolecular Forces**  or Van der Waals Forces describe the weak attraction between molecules of a molecular substance. Ionic compounds DO NOT display intermolecular forces! Three types of intermolecular forces include:

i) **London forces** – the weak attraction between the electrons of one molecule and the protons in

the nucleus of a nearby molecule. London forces increase as size of molecule increases.

ii) **Dipole-dipole forces** – the weak attraction between the slightly positive end of one polar

 molecule and the slightly negative end of a nearby polar molecule.

iii) **Hydrogen bonding** – a special type of dipole-dipole force existing between the proton of a hydrogen atom and the nearby electrons of a fluorine, nitrogen or oxygen atom. Only molecules with F – H bonds, N – H bonds or O – H bonds will display hydrogen bonding.

11. *List the type of intramolecular force and all types of intermolecular forces found in:*

 a) C6H14(l)

 b) CaCl2(s)

 c) C2H3Cl3(l)

 d) C2H5OH(l)

 e) CO2(g)

 f) NH3(g)

 g) Fe2O3(s)

12. *Identify the intermolecular forces present in the substances below and rank them in order from lowest boiling point to highest boiling point.*

C2H6(g) C2H5Cl(g) C2H5OH(l)

13. *Identify the intermolecular forces present in the substances below and describe them as having low, medium or high solubility.*

PH3(g) C4H10(g) C3H7OH(l)