**Worksheet 5.1: Bonding Introduction**

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Which groups of elements in the periodic table of elements will form
2. network covalent compounds
3. metallic compounds
4. ionic compounds

d. molecular compounds

2. Predict whether the bonding between the atoms in the following substances will be *network, metallic, ionic or covalent*.

a. KCl(s) b. Mg(s) c. CaO(s)

d. O2(g) e. NO2(g) f. Ag(s)

g. BaCl2(s) h. S8(s) i. SO2(g)

j. CsF(s) k. C4(s) l. SiC(s)

1. Define and give one characteristic for each of the following:
2. A chemical bond:
3. A covalent bond
4. An ionic bond:
5. An metallic bond:
6. A network bond:

**Worksheet 5.2: Basics of Bonding**

1. Draw energy level diagrams for:
2. 11Na23 and Na+
3. 8O15 and O2-
4. Predict and fill in the rest of the *valence shell* representations for the first 36 elements

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| 1s1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 1s2 |
| 2s1 | 2s2 |  |  |  |  |  |  |  |  |  |  | 2s22p1 | 2s22p2 |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  | 3s23p3 |  |  |  |
|  |  | 3d1  4s2 |  |  |  |  |  |  |  |  |  | 3d10 4s2  4p1 |  |  |  |  |  |

1. Draw the electron dot diagrams for the first 20 elements.

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1. Draw the electron dot diagrams for the first 14 ions. Hydrogen has two ions.

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1. Complete the following table.

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|  | **Group #** | **Gain/Lose e-** | **Name of Ion** | **Ion formula** | **Nobel Gas Most Like** |
| sodium |  |  |  |  |  |
| magnesium |  |  |  |  |  |
| sulfur |  |  |  |  |  |
| chlorine |  |  |  |  |  |

1. Name and draw the Lewis dot diagrams for 4 ionic compounds that could form from the table above.
2. Does carbon gain or lose electrons to achieve a stable electron configuration. HINT look at your periodic table.
3. What observable evidence is there that the electron structure in Noble Gases is stable?
4. Define & give an example of
5. bonding electrons
6. lone pair
7. ionic bond
8. network covalent bond
9. metallic bond
10. Based on electronegativity describe what type of bond would form between:
11. Br2
12. CO
13. Hydrogen phosphide
14. Lithium nuclei
15. Argon nuclei
16. Potassium sulfide

**Worksheet 5.3: Ionic Compounds**

1. Silver sulfide tarnish:

1. Write a balanced simple composition reaction. Identify the type of reaction. Identify the element that is undergoing reduction and the element that is undergoing oxidation.

BONUS: Write the reduction and oxidation reactions below.

1. Write out the formula unit for silver sulfide using dot diagrams.
2. Write any evidences of a reaction.
3. How could the silver sulfide tarnish removed?
4. Fertilizers are made of ammonium dihydrogen phosphate, ammonium nitrate and ammonium sulfate.
5. Write the formula unit for each compound. Verify the formula unit by showing that the net charge is zero. Identify the cation and anion.
6. Identify three physical properties that each of these compounds may have.
7. Sodium chloride, found in the Lotsberg formation below Fort Saskatchewan is in a solid crystal form. The formation is too deep to be mined.
8. Write out a reaction for the formation of sodium chloride from its elements.
9. What evidence is there that a reaction occurred?
10. What are the solubility, color and approximate melting point of sodium chloride?
11. Knowing that salt is very soluble in warm water, how could sodium chloride be removed from the ground?
12. Why is iron (III) oxide not recovered the same way as sodium chloride. (Hint: Is iron (III) oxide soluble in water)

**Worksheet 3.4: Lewis Dot diagrams for Elements**

1. Fill in the Table Below. The first one is done for you.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Name & Symbol | Total # of Valence Electrons | Electron Dot Diagram | Total # of Lone Pairs | # of Bonding Electrons in One Atom | Bonding  Capacity or Shared Pairs | Electron Configuration of one atom |
| **F**  **Fluorine** | **7** | **: F :** | **3** | **1** | **1** | **2s22p5** |
| **H** |  |  |  |  |  |  |
| **He** |  |  |  |  |  |  |
| **Be** |  |  |  |  |  |  |
| **Al** |  |  |  |  |  |  |
| **C** |  |  |  |  |  |  |
| **N2** |  |  |  |  |  |  |
| **O2** |  |  |  |  |  |  |
| **Cl2** |  |  |  |  |  |  |
| **S8** |  |  |  |  |  |  |

1. What is a covalent bond?
2. What elements form covalent bonds?
3. Using electronegativity, how do I know if I have a covalent bond?
4. What determines the bond distance?
5. What are two differences between ionic and covalent bonds?

**Worksheet 3.5: Lewis Dot Diagrams For Compounds**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Name** | **Formula** | **Total # of Valence electrons** | **Electron Dot Diagram** | **Total # of Lone Pairs** | **# & Types of Bonds**  **(single, double, triple, coordinate)** |
| Ammonia |  |  |  |  |  |
| Bromine |  |  |  |  |  |
|  |  |  | **:**O **::** O**:** |  |  |
|  |  |  | H**:**C**:::**N**:** |  |  |
|  |  |  | H  H **:**C**:** H  H |  |  |
| Dinitrogen  tetrahydride |  |  |  |  |  |
|  | N2 |  |  |  |  |
| Carbon dioxide |  |  |  |  |  |
|  | C2H6 |  |  |  |  |
|  | H3O+ |  |  |  |  |
| Acetylene |  |  |  |  |  |
| Water |  |  |  |  |  |
|  | CH3OH |  |  |  |  |
|  |  |  | **:**O **:**N**:** O**:** -  **:**O**:** |  |  |
| Phosphate ion |  |  |  |  |  |

**Worksheet 3.6: VSEPR Diagrams**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Name** | **Formula** | **Total Valence electrons** | **Electron Dot Diagram** | **VSEPR Diagram & Shape(s)** |
| ***Hydrogen cyanide*** | ***HCN(l)*** | ***10*** | ***H:C:::N:*** | ***H-C-N or H-C=N/ linear*** |
| Iodine |  |  |  |  |
|  |  |  | **O ::C:: O** |  |
|  | CO32- |  |  |  |
| Hydronium ion |  |  |  |  |
| Carbon Monoxide |  |  |  |  |
| Ethyne  (acetylene) |  |  | **H:C:::C:H** |  |
| ethanol |  |  |  |  |
|  | C2H6 |  |  |  |
| Ethanoic acid |  |  |  |  |
|  |  |  | H: S:H |  |
| Water |  |  |  |  |
|  | CH3OH |  |  |  |
| Nitrite Ion |  |  |  |  |
|  |  |  | **: O: 3-**  **: O: P :O:**  **: O:** |  |

**Worksheet 3.7: Polarity**

1. Water exposed to a positive glass rod bends towards the glass rod. Draw a water molecule turned in the right position towards the positive glass rod below.
2. Draw the bond dipole using both delta notation & vector notation for the bonds below. Indicate which has the strongest bond dipole.
3. S – O b) F – F c) C – H d) N – Br
4. Circle the following molecules that are polar. What characteristics helped you determine if they where polar?

***hydrogen chloride, hydrogen sulfide, ammonia, methane, hydrogen peroxide***

1. Fill in the Table Below. The first one is done for you.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Name & Formula** | **Lewis Dot Diagram** | **Structural diagram with electronegativity** | **VSEPR Diagram & Shape(s)**  **with overall bond dipoles if polar (any notation)** | **Polar or Nonpolar Molecule** |
| ***Hydrogen cyanide HCN(l)*** | ***H:C:::N:*** | ***2.1 2.5 3.0***  H – C = N | **∂+ ∂ --**  H – C – N linear | Polar |
| Nitrogen |  |  |  |  |
| Phosphorus trihydride |  |  |  |  |
| Dibromethane |  |  |  |  |
| Hydronium ion |  |  |  |  |
| Carbon Monoxide |  |  |  |  |
|  | **H:C:::C:H** |  |  |  |
| Ethanol |  |  |  |  |
| C2H4 |  |  |  |  |
| Water |  |  |  |  |

### Worksheet 3.8: Bonding Review

1. Complete the following table. (\* 1 is strong and 4 is weak)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Chemical Formula & name** | **Polarity**  **& number of e-** | **Melting Point** | **Boiling Point** | **VSEPR Diagram**  **With bond dipoles if polar** | **Types of Intermolecular Forces** | **Rank Inter-molecular strength\*** |
| F2(g) |  | -220 | -188 |  |  |  |
| I2(s) |  | 114 | 184 |  |  |  |
| Cl2(g) |  | -101 | -35 |  |  |  |
| Br2(l) |  | -7 | 59 |  |  |  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| ICl(g) |  | 14 | 97 |  |  |  |
| BrF(g) |  | -33 | -20 |  |  |  |
| ClF(g) |  | -154 | -101 |  |  |  |
| BrCl(g) |  | -66 | 5 |  |  |  |
| CH3OH(l) |  | -100 | 65 |  |  |  |
| CH3I(l) |  | -66 | 43 |  |  |  |
| CH3Br(g) |  | -94 | 4 |  |  |  |
| CH3Cl(g) |  | -98 | -24 |  |  |  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| C2H5Br(l) |  | -119 | 38 |  |  |  |
| C2H5I(l) |  | -108 | 72 |  |  |  |
| C2H5OH(l) |  | -117 | 78 |  |  |  |
| C2H5F(g) |  | -143 | -38 |  |  |  |

1. Rank the following in order of increasing melting point. Give reasons to support your answer.

**RANK (1 is low; 8 is high)** **REASONS( bond type, intermolecular forces, # of e-)**

\_\_\_ Sodium chloride:

\_\_\_ Water:

\_\_\_ Methane:

\_\_\_ Hydrogen chloride:

\_\_\_ Hydrogen gas:

\_\_\_ Methanol:

\_\_\_ Silicon carbide:

\_\_\_ Iron metal:

1. Use the observations about five solids below to fill in the table that follows.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| SOLID | COLOR | ODOR | HARDNESS | OTHER |
| A | Yellow | Slight | Moderate | Melts over flame |
| B | White | None | Hard | Dissolves in water & conducts electricity |
| C | White | Strong | Soft | Melts over a flame |
| D | Grey | None | Very hard | None |
| E | Silver | None | Hard | None |

|  |  |  |
| --- | --- | --- |
| **Letter, Name & Formula** | **Type of Intra-& Interbonds /forces** | **Explain how you identified the substances** |
| sodium chloride  Formula:\_\_\_\_  Letter:\_\_\_\_ |  |  |
| **silicon carbide**  Formula: \_\_\_\_  Letter:\_\_\_\_ |  |  |
| **iron**  Formula: \_\_\_\_  Letter: \_\_\_\_ |  |  |
| **Sulfur**  Formula:\_\_\_\_\_  Letter: \_\_\_\_ |  |  |
| **dichlorobenzene** Formula:C6H4Cl2(s)  Letter: \_\_\_\_\_ |  |  |

1. A person is analyzing the five compounds below. Answer the questions that follow. CH4, CH3Cl, CH2Cl2, CHCl3, CCl4

* Draw the Lewis diagrams
* List the five compounds in order of increasing boiling points.
* List the five compounds from the most non-polar to the most polar compounds

1. Complete the following table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Formula & Name** | **Lewis Diagram** | **VSEPR Shape** | Polarity | **Type of Bonds/Forces** |
| ammonia |  |  |  |  |
| CBr4  tetrabromomethane |  |  |  |  |
| H2S |  |  |  |  |
| PCl3 |  |  |  |  |
| BCl3 |  |  |  |  |
| ammonium ion |  |  |  |  |
| hydrogen bromide |  |  |  |  |
| CO2 |  |  |  |  |
| NI3 |  |  |  |  |
| SO42- |  |  |  |  |
| SBr2 |  |  |  |  |
| GeH4 |  |  |  |  |
| H2Te |  |  |  |  |
| nitrogen trifluoride |  |  |  |  |
| H2Se |  |  |  |  |
| SnBr4 |  |  |  |  |
| SO32- |  |  |  |  |