Name

Intra vs. Inter molecular forces

1. What are the different types of Solids? molecular covalent, ionic, network covalent, metallic

2. What types of atoms can undergo Network Covalent bonding.
C Si Ge

3. When a Network Covalent substance is melted, what type of bond must be broken?
covalent

4. What type of attractions are broken when a covalent solid is melted?
* If Network covalent → covalent
* If molecular covalent → intermolecular H bond/dipole dipole

5. Fill in the table below relative to the intermolecular forces indicated in #4.

Type of intermolecular force	hydrogen bonding	dipole-dipole
Factors affecting strength of force	polarity + symmetry	

6. When a sample of NaCl is being melted, what force is being broken? ionic bond

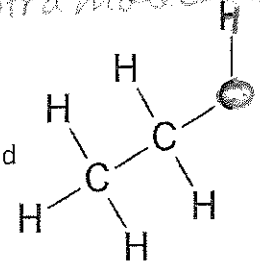
   a. What are the factors that affect the strength of an ionic compound?
Coulombs → charge and radius (distance)

   b. With what you know about the strength of ionic compounds, write out 3 different ionic compounds and list them in order of increasing melting points.
NaCl < MgO < Al_2S_3 (by charge) NaI < NaCl < NaF (by distance (radius))

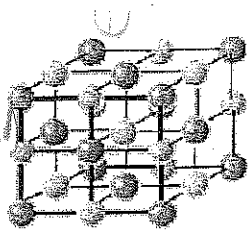
7. What is the fundamental difference between ionic and molecular (covalent) substances when melting? Ionic - must break ionic bonds to melt

Covalent - covalent bonds do not break, intramolecular bonds break

8. What type of substance is at the right (covalent, covalent network, ionic)
9. What are the factors affecting its melting points? covalent bond polarity
10. Will this substance dissolve in water? If so draw a few water molecules orientated around the molecule.



11. What type of substance is at the right (covalent, covalent network, ionic)
12. What are the factors affecting its melting points? charge + size of ion
13. Will this substance dissolve in water? If so draw a few water molecules orientated around the molecule. yes



14. List the following substances in increasing melting points.
   a. $CaCl_2$, NaCl, H_2O, He, C(diamond) He, H_2O, NaCl, $CaCl_2$, C diamond
   b. AlP, I_2, F_2, CO_2, O_2

F_2, O_2 < CO_2, I_2, AlP

NAME
CHEMISTRY
Percent Composition by Mass

Notes:

$C_6H_{12}O_6$: One mole of Glucose weighs 180g. How much of the 180 grams is due to the carbon.

C: 6* 12.01 = 72.06g in 1 mole
H: 12 * 1.00 = 12.00g in 1 mole
O: 6 * 15.99 = 95.94g in 1 mole

180g/mol

C: 72.06/180 * 100 = 40.03%
H: 12.00/180 * 100 = 6.667%
O: 95.94/180 * 100 = 53.30%

Determine the percent by mass for the following substances

1. CO_2 C 1×12 } 44g/mol O 2×16 }
   $\frac{12}{44} \times 100 = 27.3\%$ C
   $\frac{32}{44} \times 100 = 72.7\%$ O

2. H_2O H 2×1=2 } 18g/mol O 1×16=16 }
   $\frac{2}{18} \times 100 = 11.1\%$ H
   $\frac{16}{18} \times 100 = 88.9\%$ O

3. XeF_6 Xe 1×131.30 = 131.3 } 245.3 g/mol F 6×19.00 = 114.0 }
   $\frac{131.3}{245.3} \times 100 = 53.5\%$ Xe
   $\frac{114}{245.3} \times 100 = 46.5\%$ F

4. N_2O_5 N 2×14 = 28 } 108g/mol O 5×16 = 80 }
   $\frac{28}{108} \times 100 = 25.9\%$ N
   $\frac{80}{108} \times 100 = 74.1\%$ O

5. P_4O_{10} P 4×30.97 = 123.88 O 10×16.00 = 160.00 283.88
   $\frac{123.88}{283.88} \times 100 = 43.6\%$ P
   $\frac{160}{283.88} \times 100 = 56.4\%$ O

6. Which of the following Alkaline Earth metal oxides has the highest percent oxygen?

   BeO MgO CaO SrO BaO

   Be 9.01 O 16 — 137.33 16

Determine the mass of each element in the sample.

7. 90 g CO_2
   $90g(0.273) = 24.6g$ C
   $90g(0.727) = 65.4g$ O

8. 37g H_2O
   $37g(0.111) = 4.1g$ H
   $37g(0.889) = 32.9g$ O

Name
Chemistry
Percent by Mass / Percent by volume

Notes:

Percent by mass = mass of x / total mass x 100

Percent by volume = volume of x / total volume x 100

1. If a compound car has a total mass of 4040 lbs. of which 600 lbs. is due to the engine. What is the percent mass of the engine relative to the car?

$\frac{600\ lbs}{4040\ lbs} \times 100 = 14.8\%$ mass of the engine

2. A fruit drink has a volume of 356. mL but is only 10% juice. What is the volume of the juice?

$\frac{x}{356\ mL} = \frac{10}{100}$

$x = 35.6\ mL$ juice

10% of 356 = ?
0.10 x 356 = 35.6 mL juice

3. A adult male has a body fat percentage of 12%. What is the total mass of fat if the individual weighs 220. lbs?

$\frac{x}{220\ lbs} = \frac{12}{100}$ $x = 26.4\ lbs$ fat

12% of 220 = ?
0.12 x 222 = 26.4 lbs fat

4. A adult male has a body fat percentage of 12%. How much would the person have to weigh if the individual has a total of 50lbs of fat.

$\frac{50\ lbs}{x} = \frac{12}{100}$ $x = 417\ lbs$

12% of ? = 50
0.12 x = 50
x = 416 lbs

5. A solution contains 25 mL of H_2O and 50 mL of ethyl alcohol. What is the percent by volume of water?

$\frac{vol\ of\ x}{total\ vol} \times 100 = \frac{25\ mL\ H_2O}{25\ mL + 50\ mL} \times 100 = \frac{25}{75} \times 100 = 33.3\%\ H_2O$

6. A solution contains 25 mL of H_2O and 50 mL of ethyl alcohol. What is the percent by volume of ethyl alcohol?

$\frac{50\ mL}{75\ mL} \times 100 = 66.7\%$ ethyl alcohol

7. The human body is 60% water by mass. If an individual has a mass of 200 lbs. How many liters of water are present in this individual?
(2.2lbs = 1 kg Density of water: 1kg = 1L)

$\frac{x}{200\ lbs} = \frac{60}{100}$

$y = 120\ lbs$

$120\ lbs \left| \frac{1\ kg}{2.2\ lbs} \right| \frac{1\ L}{1\ kg} = 54.5\ L\ H_2O$

NAME
PERCENT COMPOSITION I

Empirical Formula: Simplest ratio of Atoms

C = 80% H = 20%

Determining Empirical Formula

1. Convert % mass to mass.
   - Given a 100 gram sample
     - 80g C & 20g H
2. Convert mass to number of particles (moles)
   - 80g C * (1mol/12.01g) = 6.66 mol
   - 20g H * (1mol/1g) = 20 mol
3. Divide out all the moles by the smallest value. This gives simplest ratio. Automatically sets the smallest value to 1.
   - C: 6.66/6.66 = 1 Empirical = CH_3
   - H: 20.0/6.66 = 3
4. What happens if the smallest value of the empirical value is not 1. You will get a fraction.
   - N: 1
   - O = 2.5 or 2 ½ In this case you can't have a half an atom.
   - Multiply by the reciprocal of the fraction, in this case that would be 2.
     - Empirical = N_2O_5

REVIEW:

1. Convert CO_2 to Percent Mass

C 1x12 } 44 g/mol $\frac{12}{44} \times 100 = 27.3\%$ C

O 2x16 } $\frac{16}{44} \times 100 = 72.7\%$ O

With results convert back to empirical formula.

(1) 27.3 g C 72.7 g O

(2) $27.3\text{g C} \times \frac{1\text{mol C}}{12\text{g C}} = 2.28\text{ mol C}$

$72.7\text{g O} \times \frac{1\text{mol O}}{16\text{g O}} = 4.54\text{ mol O}$

(3) $\frac{2.28}{2.28} = 1$ C $\frac{4.54}{2.28} = 2$ O → CO_2

2. Convert N_2O_5 to percent mass

N 2x14 = 28 }
O 5x16 = 80 } 108 $\frac{28}{108} \times 100 = 25.9\%$ N

$\frac{80}{108} \times 100 = 74.1\%$ O

With results convert back to empirical formula.

(1) 25.9 g N 74.1 g O

(2) $25.9\text{g N} \times \frac{1\text{mol N}}{14\text{g N}} = 1.85\text{ mol N}$

$74.1\text{g O} \times \frac{1\text{mol O}}{16\text{g O}} = 4.63\text{ mol O}$

(3) $\frac{1.85}{1.85} = 1$ $\frac{4.63}{1.85} = 2.5$ (x2)

(4) 1x2 → 2N 5O → N_2O_5

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1. Cl = 71.65%
   C = 24.27%
   H = 4.07%

Determine Empirical Formula:

$71.65\text{g Cl} \times \frac{1\text{mol Cl}}{35.5\text{g Cl}} = 2$ Cl

$24.27\text{g C} \times \frac{1\text{mol C}}{12\text{g C}} = 2$ C

$4.03\text{g H} \times \frac{1\text{mol H}}{1\text{g}} = 4$ H

→ C_2H_2Cl

2. P = 43.64% O= 56.36%

Determine the empirical formula

$43.64\text{g P} \left|\frac{1\text{mol P}}{30.97\text{g P}}\right. = 1.41\text{ mol P}$ $\frac{1.41}{1.41} = 1$ $\xrightarrow{\times 5}$ 2 P

$56.36\text{g O} \left|\frac{1\text{mol O}}{16.0\text{g O}}\right. = 3.5\text{ mol O}$ $\frac{3.5}{1.41} = 2.5$ $\xrightarrow{\times 2}$ 5 O

P_2O_5

3. C = 26.4 H = 5.6% N= 67.9%

Determine Empirical Formula:

$26.4\text{g C} \left|\frac{1\text{mol C}}{12\text{g C}}\right. = 2.2\text{mol C}$ $\frac{2.2}{2.2} = 1$ $(\times 10) = 10$ C

$5.6\text{g H} \left|\frac{1\text{mol H}}{1\text{g H}}\right. = 5.6\text{ mol H}$ $\frac{5.6}{2.2} = 2.5$ $(\times 10) = 25$ H

$67.9\text{g N} \left|\frac{1\text{mol N}}{14\text{g N}}\right. = 4.85\text{mol N}$ $\frac{4.85}{2.2} = 2.2$ $(\times 10) = 22$ N

$C_{10}H_{25}N_{22}$

5. C = 40% H = 6.6% O = 53.3%

Determine Empirical Formula:

$40\text{g C} \left|\frac{1\text{mol C}}{12\text{g C}}\right. = 3.33\text{ mol C}$ $\frac{3.33}{3.33} = 1$ C

$6.6\text{g H} \left|\frac{1\text{mol H}}{1\text{g H}}\right. = 6.6\text{ mol H}$ $\frac{6.6}{3.33} = 2$ H

$53.3\text{g O} \left|\frac{1\text{mol O}}{16\text{g O}}\right. = 3.33\text{mol O}$ $\frac{3.33}{3.33} = 1$ O

CH_2O

6. K = 45.9% N = 16.5% O = 37.6%

Determine Empirical Formula

$45.9\text{g K} \left|\frac{1\text{mol K}}{39.1\text{g K}}\right. = 1.17$ $\frac{1.17}{1.17} = 1$ K

$16.5\text{g N} \left|\frac{1\text{mol N}}{14\text{g N}}\right. = 1.18$ $\frac{1.18}{1.17} = 1$ N

$37.6\text{g O} \left|\frac{1\text{mol O}}{16\text{g O}}\right. = 2.35$ $\frac{2.35}{1.17} = 2$ O

KNO_2

7. Na = 42.1% P= 18.9% O = 39.0%

Determine Empirical Formula

$42.1\text{g Na} \left|\frac{1\text{mol Na}}{23\text{g Na}}\right. = 1.83\text{ mol Na}$ $\frac{1.83}{0.61} = 3$ Na

$18.9\text{g P} \left|\frac{1\text{mol P}}{30.97\text{g P}}\right. = 0.61\text{mol P}$ $\frac{0.61}{0.61} = 1$ P

$39.0\text{g O} \left|\frac{1\text{mol O}}{16\text{g O}}\right. = 2.44\text{ mol O}$ $\frac{2.44}{0.61} = 4$ O

Na_3PO_4

8. Pb = 68.3% S = 10.6% O = 21.1%

Determine Empirical Formula

$68.3\text{g Pb} \left|\frac{1\text{mol Pb}}{207.2\text{g Pb}}\right. = 0.33$ $\longrightarrow$ 1 Pb

$10.6\text{g S} \left|\frac{1\text{mol S}}{32.06\text{g S}}\right. = 0.33$ $\longrightarrow$ 1 S

$21.1\text{g O} \left|\frac{1\text{mol O}}{16\text{g O}}\right. = 1.32$ $\frac{1.32}{0.33} = 4$ O

$PbSO_4$

8. N = 11.6% Cl = 88.4%

Determine Empirical Formula

$11.6\text{g N} \left|\frac{1\text{mol N}}{14\text{g N}}\right. = 0.82\text{ mol N}$ $\Longrightarrow$ 1 N

$88.4\text{g Cl} \left|\frac{1\text{mol Cl}}{35.5\text{g Cl}}\right. = 2.5\text{ mol Cl}$ $\frac{2.5}{0.82} = 3$ Cl

NCl_3

Name

PERCENT COMPOSITION II

Notes

Determining the molecular formula from the empirical formula.

- What is the relationship between the empirical and molecular formula?
  - The molecular formula is some multiple of the empirical formula
    - CH_4 = empirical
    - Potential molecular formulas
      - CH_4, C_2H_8, C_3H_{12} or C_4H_{16}.....
  - Calculation
  - Molecular weight/Empirical weight = Multiple
    - CH_4 = 16g/mol and the molecular weight = 32g/mol
    - 32/16 = 2
    - C_2H_8 = molecular formula

Determine empirical formula

1. N = 46.7% O = 53.3%

$46.7\text{g N} \times \frac{1\text{mol}}{14\text{g}} = 3.33$ $\quad \frac{3.33}{3.33} = 1$ N

$53.3\text{g O} \times \frac{1\text{mol}}{16\text{g}} = 3.33$ $\quad \frac{3.33}{3.33} = 1$ O

NO

2. C = 92.3% H = 7.70%

$92.3\text{g C} \times \frac{1\text{mol}}{12\text{g C}} = 7.7$ C $\quad \frac{7.7}{7.7} = 1$

$7.7\text{g H} \times \frac{1\text{mol H}}{1\text{g H}} = 7.7$ H $\quad \frac{7.7}{7.7} = 1$

CH

3. C = 75.0% H = 25.0%

$75\text{g C} \times \frac{1\text{mol C}}{12\text{g C}} = 6.25$ $\quad \frac{6.25}{6.25} = 1$

$25\text{g H} \times \frac{1\text{mol H}}{1\text{g H}} = 25$ $\quad \frac{25}{6.25} = 4$

CH_4

Determine empirical and molecular formula:

4. C = 80% H = 20% M.W. = 30.0

$80\text{g C} \times \frac{1\text{mol C}}{12\text{g C}} = 6.67\text{mol C}$ $\quad \frac{6.67}{6.67} = 1$

$20\text{g H} \times \frac{1\text{mol H}}{1\text{g H}} = 20\text{mol H}$ $\quad \frac{20}{6.67} = 3$

CH_3 $\quad 12 + 3 = 15$ (EW)

$\frac{(MW)}{(EW)} \frac{30}{15} = 2$

C_2H_6

5. C = 62% H = 10.4% O = 27.5% M.W. = 58.1

$62\text{g C} \times \frac{1\text{mol C}}{12\text{g C}} = 5.17\text{mol C}$ $\quad \frac{5.17}{1.72} = 3$

$10.4\text{g H} \times \frac{1\text{mol H}}{1\text{g H}} = 10.4\text{mol H}$ $\quad \frac{10.4}{1.72} = 6$

$27.5\text{g O} \times \frac{1\text{mol O}}{16\text{g O}} = 1.72\text{mol O}$ $\quad = 1$

C_3H_6O

$36 + 6 + 16 = 58$

↑ same as MW

C_3H_6O

6. C = 40.0% H = 6.7% O = 53.3% M.W. = 60.0

$40\text{g C} \times \frac{1\text{mol C}}{12\text{g C}} = 3.33 \longrightarrow 1$

$6.7\text{g H} \times \frac{1\text{mol H}}{1\text{g H}} = 6.7$ $\quad \frac{6.7}{3.33} = 2$

$53.3\text{g O} \times \frac{1\text{mol O}}{16\text{g O}} = 3.33 \longrightarrow 1$

CH_2O

$12 + 2 + 16 = 30$

$\frac{60}{30} = 2$

$C_2H_4O_2$

7. C = 40.92% H = 4.58% O = 54.51% M.W. = 176.1

$40.92\text{g C} \times \frac{1\text{mol C}}{12\text{g C}} = 3.41 \longrightarrow 1$ $\quad \times 3 = 3$

$4.58\text{g H} \times \frac{1\text{mol H}}{1\text{g H}} = 4.58$ $\quad \frac{4.58}{3.41} = 1.34$ $\quad \times 3 = 4$

$54.51\text{g O} \times \frac{1\text{mol O}}{16\text{g O}} = 3.41 \longrightarrow 1$ $\quad \times 3 = 3$

$C_3H_4O_3$

$36 + 4 + 48$

87g/mol

$\frac{176.1}{87} = 2$

$C_6H_8O_6$

8. C = 46.3% H = 3.90% N = 27.0% O = 20.71% M.W. = 155

$46.3\text{g C} \times \frac{1\text{mol C}}{12\text{g C}} = 3.86\text{mol C}$

3.9mol H $\quad \frac{3.86}{1.29} = 3$ C

$27\text{g N} \times \frac{1\text{mol N}}{14\text{g N}} = 1.93\text{mol N}$ $\quad \frac{20.71}{16} = 1.29$ O $\quad N = 1.5$

$\frac{3.9}{1.29} = 3$ H $\quad O = 1$

$C_6H_6N_3O_2$

$72 + 6 + 42 + 32 = 152\text{g/mol}$

Honors Chemistry

States of matter Pre-quiz

C N C I I

CCl_4 SiC NH_3 $AlCl_3$ KCl He

1. Which of the above substances are molecular?

CCl_4 NH_3 He

hint nonmetals only not 2 ions

2. Which of the above substances is an ionic bulk crystal?

$AlCl_3$ KCl

hint 2 ions... Al^{+3} Cl^{-1} K^{+1} Cl^{-1}

3. Which of the above substances is a network covalent?

SiC

hint have Si, C, Ge

4. Which substance here is likely to have the highest melting point?

SiC

hint covalent network has highest MP

5. Which substance is likely to have the lowest melting point?

He ?

hint non-polar covalent molecule

6. Which substance is likely most likely to be a gas?

He

hint molecular covalent non-polar: less intramolecular bonding

7. Which will have the higher melting point, explain? ($AlCl_3$ or KCl)

$AlCl_3$ Al^{+3} Cl^{-1} K^{+1} Cl^{-1} $AlCl_3$ has higher charge (more Coulombic attraction)

8. Ammonia (NH_3) at room temperature can be a liquid where as both N_2 and H_2 are both gases independently.

   a. Draw a Lewis structure of NH_3, N_2 and H_2.

   b. What about NH_3 makes it a liquid? Explain.

NH_3 is polar covalent, which means there are intramolecular bonds (H-bonds) The bonds will "hold" it together at a higher temperature