

Ap Chem Summer Assignment #1

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1 Summer Assignment 1

1.1 How many significant figures are there each of the following values

1. 4 significant figures
2. 4 significant figures
3. 7 significant figures
4. 6 significant figures
5. 1 significant figures
6. 5 significant figures
7. 6 significant figures

1.2 Perform the indicated calculations on the following measured values, giving the final answer with the correct number of significant figures.

1. $16.81 + 3.2257 = 20.0357 \approx 20.04$
2. $324.6 * 815.991 = 264870.6786 \approx 264900$
3. $2.85 + 3.4621 + 1.3 = 7.6121 \approx 7.6$
4. $7.442 - 7.429 = 0.013$
5. $1.65 * 14 = 23.1 \approx 23$
6. $\frac{27}{4.148} = 6.509161 \approx 6.5$

$$7. \left[\frac{(3.901-3.887)}{3.901} \right] * 1.00 = \left[\frac{0.014}{3.901} \right] * 1.00 = 0.0036 * 1.00 = 0.0036$$

$$8. 6.404 * 2.91 * (18.7 - 17.1) = 6.404 * 2.91 * 1.6 \approx 30$$

1.3 A sample of motor oil with a mass of 440 g occupies 500 mL. What is the density of the motor oil?

We can utilize the formula $d = \frac{m}{v}$ (density = mass/volume)

$$\begin{aligned} d &= \frac{m}{v} \\ &= \frac{440g}{500mL} \\ &= 0.88 \frac{g}{mL} \\ &\approx 0.9 \frac{g}{mL} \end{aligned}$$

1.4 The density of an object is 16.3 g/mL. Its volume is 0.125 L. What is the mass of the object?

We can apply vector analysis to solve for the correct units

$$\frac{16.3g}{1mL} \frac{1000 \text{ mL}}{1L}$$

$$= 16300g/L$$

We can apply the same $d = \frac{m}{v}$ to calculate for mass

$$16300g/L = \frac{m}{0.125mL} \tag{1}$$

Re-arranging the equation in terms of mass, we get the following

$$\begin{aligned} m &= 16300 * 0.125 \\ &= 2037.5g \\ &\approx 2040g \end{aligned}$$

- 1.5 A sample of uranium weighing 30.923 g was dropped in a graduated cylinder containing 22.30 mL of water. The volume of the water plus the sample was 23.90 mL. What is the density of uranium?**

The volume of the object is going to be the difference between the volume of the water and the volume of the water + object.

$$23.90mL - 22.30mL = 1.60mL \quad (2)$$

We can apply the same $d = \frac{m}{v}$ to calculate for density

$$\begin{aligned} d &= \frac{m}{v} \\ &= \frac{30.923g}{1.60mL} \\ &= 19.33 \frac{g}{mL} \\ &\approx 19.3 \frac{g}{mL} \end{aligned}$$

- 1.6 How many protons, neutrons and electrons are in each of the following ions?**

1. Protons = 26. Neutrons = 30. Electrons = 23
2. Protons = 20. Neutrons = 20. Electrons = 18
3. Protons = 9. Neutrons = 10. Electrons = 10
4. Protons = 15. Neutrons = 16. Electrons = 18
5. Protons = 53. Neutrons = 74. Electrons = 54
6. Protons = 53. Neutrons = 74. Electrons = 46

- 1.7 TODO Given the position in the periodic table, what is the most likely oxidation state (or common ion charge) that each element will have when forming an ion?**

- 1.8 Would you expect the following atoms to gain or lose electrons when forming an ion? If so, how many would be gained or lost?**

1. Be is in Group 2, therefore it will lose 2 electrons (and have a +2 charge)

2. Cl is in Group 17, therefore it will gain 1 electron (and have a -1 charge)
3. Al is in group 13, therefore it will gain 3 electrons (and have a -3 charge)
4. O is in group 16, therefore it will gain 2 electrons (and have a -2 charge)
5. F is in group 17, therefore it will gain 1 electron (and have a -1 charge)
6. Li is in group 1, therefore it will lose 1 electron (and have a +1 charge)

1.9 Name each of the following compounds:

1. PbI_2 is named as Lead(II) iodide
2. NH_4Cl is named as Ammonium chloride
3. Fe_2O_3 is named as Iron(III) oxide
4. LiH is named as Lithium hydride
5. CsCl is named as Caesium chloride
6. $\text{Cr}(\text{OH})_3$ is named as Chromium hydroxide
7. $\text{NaC}_2\text{H}_3\text{O}_2$ is named as Sodium acetate
8. $\text{K}_2\text{Cr}_2\text{O}_7$ is named as Potassium dichromate
9. Na_2SO_4 is named as Sodium sulfate

1.10 Which of the following particulate diagrams best shows the formation of water vapor from hydrogen gas and oxygen gas in a rigid container at 125° C?

The correct answer would be **C**. Both Oxygen and Hydrogen exist freely as molecules with two atoms each, which eliminates options A and B. As the chemical composition of water is H_2O , there need to be twice as many hydrogen molecules as oxygen molecules, and so C is the only answer that makes sense.

1.11 Name each of the following compounds. In addition, for the compounds in letters a-c, draw Lewis structures, predict VSEPR geometry and hybridization.

NI_3 is named as Nitrogen triiodide, and has the following Lewis Structure. It has a Trigonal pyramidal shape with 109.5° bond angles, and has a SP^3 hybridization



NH_3 is named as Ammonia, and has the following Lewis Structure. It has a tetrahedral shape with 107° bond angles, and has a SP^3 hybridization



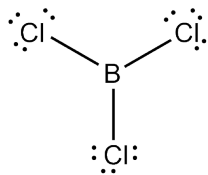
CO is named as Carbon monoxide, and has the following Lewis Structure. It has a linear shape with 180° Bond angles, and has a SP hybridization



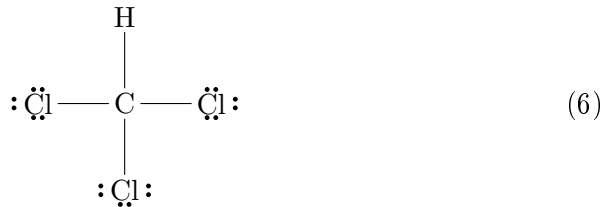
P_4O_{10} is named as Tetraphosphorus decoxide, N_2O_4 is named as Dinitrogen tetroxide, PCl_3 is named as Phosphorus trichloride

1.12 Molecules that have geometries in one plane include which of the following? Draw the Lewis structures to prove your point

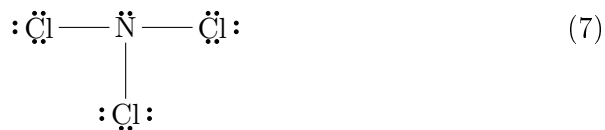
The lewis structure for BCl_3



The lewis structure for CHCl_3 is



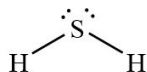
The lewis structure for NCl_3 is



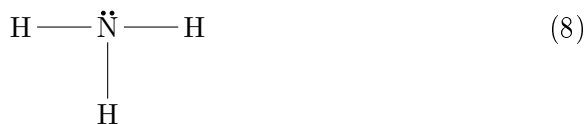
Therefore, the correct option is **A**. Both options II and III are tetrahedral and trigonal pyramidal respectively. Option I (BCl_3) is the only one that has a geometry in one plane (trigonal planar)

1.13 The electron-dot structure (Lewis structure) for which of the following molecules would have two lone pairs of electrons on the central atom? Again, draw the Lewis structures to prove your point.

The lewis structure for H_2S is



The lewis structure for NH_3 is



The lewis structure for CH_4 is



The lewis structure for HCN is

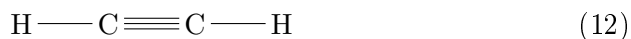


The lewis structure for CO_2 is

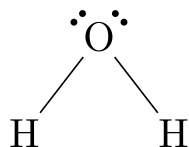


1.14 Draw Lewis structures for (a) C₂H₂, (b) H₂O, (c) NH₃, (d) HCl (e) CCl₄

The lewis structure for C₂H₂ is



The lewis structure for H₂O is



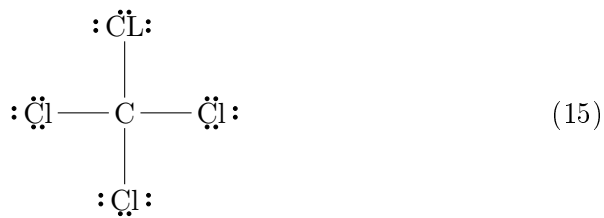
The lewis structure for NH₃ is



The lewis structure for HCL is



The lewis structure for CCl₄ is



1.15 TODO Give the VSEPR geometry for each for each of the molecules listed in #14.

1.16 TODO Tell whether each of the molecules listed in #14 is polar or nonpolar.

1.17 TODO What primary type of intermolecular force (IMFs) would attract the molecules in #14. Which molecules would have the highest boiling points? The lowest? (Just estimate based on what you know.)

1.18 Name each of the following compounds:

1. P₄O₆ is named as Phosphorus trioxide

2. KOH is named as Potassium hydroxide
3. N₂ is named as Dinitrogen (or Nitrogen Gas)
4. PH₃ is named as Phosphane
5. BF₃ is named as Boron trifluoride
6. AgCl is named as Silver(I) chloride
7. KHCO₃ is named as Potassium hydrogen carbonate
8. AgNO₃ is named as Silver nitrate

1.19 Write formulas for each of the following compounds:

1. The formula for sodium cyanide is NaCN
2. The formula for tin(II) fluoride is SnF₂
3. The formula for lead(II) nitrate is PbF₂
4. The formula for iron(III) oxide is FeF₃
5. The formula for calcium phosphate is Ca₃(PO₄)₂
6. The formula for sodium bromate is NaBrO₃
7. The formula for hydrogen iodide is HI
8. The formula for sodium sulfate is Na₂SO₄
9. The formula for manganese dioxide is MnO₂
10. The formula for potassium chlorate is KClO₃
11. The formula for potassium hypochlorite is KClO
12. The formula for lithium hydride is LiH
13. The formula for barium chloride is BaCl₂
14. The formula for magnesium oxide is MgO
15. The formula for copper(I) oxide is Cu₂O

1.20 Give the names of the following acids

1. H_2SO_3 is named as Sulfurous acid
2. HI is named as Hydroiodic acid
3. HBr is named as Hydrobromic acid
4. HNO_2 is named as Nitrous acid
5. H_3PO_4 is named as Phosphoric Acid
6. HCl is named as Hydrochloric acid

1.21 Give the names and formulas of the seven diatomic elements.

1. H_2 , or Hydrogen
2. N_2 , or Nitrogen
3. O_2 , or Oxygen
4. F_2 , or Fluorine
5. Cl_2 , or Chlorine
6. Br_2 , or Bromine
7. I_2 , or Iodine

1.22 Solve the following problems involving scientific notation without a calculator.

1. The solution is $8 * 10^7$

$$\begin{aligned}(2 * 10^3)(4 * 10^4) &= (2 * 4)(10^3 * 10^4) \\ &= 8(10^3 * 10^4) \\ &= 8 * 10^{3+4} \\ &= 8 * 10^7\end{aligned}$$

2. The solution is $42 * 10^{11}$

$$\begin{aligned}(6 * 10^5)(7 * 10^6) &= (6 * 7)(10^5 * 10^6) \\ &= 42(10^5 * 10^6) \\ &= 42 * 10^{5+6} \\ &= 42 * 10^{11}\end{aligned}$$

3. The solution is $105 * 10^{12}$

$$\begin{aligned}(7 * 10^4)(5 * 10^6)(3 * 10^2) &= (7 * 5 * 3)(10^4 * 10^6 * 10^2) \\ &= 105(10^4 * 10^6 * 10^2) \\ &= 105 * 10^{4+6+2} \\ &= 105 * 10^{12}\end{aligned}$$

4. The solution is $2.5 * 10^3$

$$\begin{aligned}\frac{(2 * 10^7)}{(8 * 10^3)} &= \frac{(20000000)}{(8 * 10^3)} \\ &= \frac{(20000000)}{(8000)} \\ &= 2500 \\ &= 2.5 * 10^3\end{aligned}$$

5. The solution is $2 * 10^2$

$$\begin{aligned}\frac{(4 * 10^6)}{(2 * 10^4)} &= \frac{(4000000)}{(2 * 10^4)} \\ &= \frac{(4000000)}{(20000)} \\ &= 200 \\ &= 2 * 10^2\end{aligned}$$

6. The solution is $5 * 10^{10}$

$$\begin{aligned}\frac{(2 * 10^3)}{(4 * 10^{-8})} &= \frac{(2000)}{(4 * 10^{-8})} \\ &= \frac{(2000)}{(0.00000004)} \\ &= 50000000000 \\ &= 5 * 10^{10}\end{aligned}$$

7. The solution is $6 * 10^8$

$$\begin{aligned}\frac{(5 * 10^6)(2 * 10^3)(3 * 10^3)}{(5 * 10^4)} &= \frac{(5 * 2 * 3)(10^6 * 10^3 * 10^3)}{(5 * 10^4)} \\ &= \frac{(30)(10^{6+3+3})}{(5 * 10^4)} \\ &= \frac{(30)(10^{12})}{(5 * 10^4)} \\ &= \frac{(3 * 10^{13})}{(5 * 10^4)} \\ &= \frac{(3 * 10^9)}{5} \\ &= 600000000 \\ &= 6 * 10^8\end{aligned}$$

8. The solution is $5 * 10^2$

$$\begin{aligned}\frac{(4 * 10^6)(5 * 10^{-3})}{(8 * 10^{-4})(5 * 10^3)} &= \frac{(4 * 5)(10^6 * 10^{-3})}{(8 * 5)(10^{-4} * 10^3)} \\ &= \frac{(20)(10^{6-3})}{(40)(10^{-4+3})} \\ &= \frac{(20)(10^3)}{(40)(10^{-1})} \\ &= \frac{2000}{4} \\ &= 500 \\ &= 5 * 10^2\end{aligned}$$

1.23 The structures and normal boiling points of dimethyl ether and ethanol are given in the table above.

1.23.1 Which of the following diagrams best helps to explain the difference in boiling point of the two compounds?

1.23.2 Describe your reasoning for selecting the answer you did and specifically identify the type of intermolecular forces represented.