Ap Chem Summer HW

Shaurya Singh

June 30, 2021

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

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)

$$
\begin{aligned}
d &= \frac{m}{v} \\
&= \frac{440g}{500mL} \\
&= 0.88\frac{g}{mL} \\
&\approx 0.9\frac{g}{mL}
\end{aligned}
\tag{1}
$$

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

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

$$
= 16300g/L
$$

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

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

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

$$
\begin{aligned}
m &= 16300 * 0.125 \\
&= 2037.5g \\
&\approx 2040g
\end{aligned}
\tag{2}
$$

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.

$$23.90mL - 22.30mL = 1.60mL$$

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

$$\begin{aligned}
d &= \frac{m}{v} \\
&= \frac{30.923g}{1.60mL} \\
&= 19.33\frac{g}{mL} \\
&\approx 19.3\frac{g}{mL}
\end{aligned} \tag{3}$$

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 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. 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 5 electrons (and have a -5 charge)

4. *O* is in group 16, therefore it will gain 8 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)

1.8   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. $Cr(OH)_1$ is named as Chromium hydroxide

7. $NaC_2H_2O_2$ is named as Sodium acetate

8. $K_2Cr_2O_7$ is named as Potassium dichromate

9. Na_2SO_4 is named as Sodium sulfate

1.9   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.

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

1. 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 SP3 hybridization

$$:\ddot{\ddot{I}}\text{---}\ddot{N}\text{---}\ddot{\ddot{I}}: \qquad\qquad (4) $$
$$ | $$
$$:\ddot{I}: $$
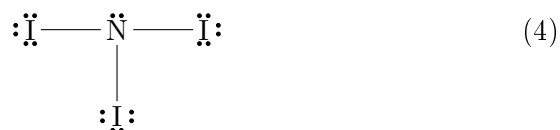
2. NH_3 is named as Ammonia, and has the following Lewis Structure. It has a tetrahedral shape with 107° bond angles, and has a SP3 hybridization
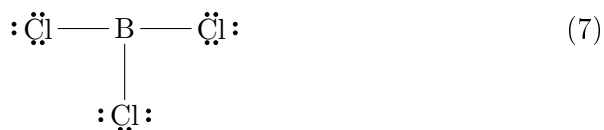
$$ \text{H}\text{---}\ddot{N}\text{---}\text{H} \qquad\qquad (5) $$
$$ | $$
$$ \text{H} $$

3. 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

$$:\text{C}\equiv\text{O}: \qquad\qquad (6) $$

4. P_4O_{10} is named as Tetraphosphorus decoxide

5. N_2O_4 is named as Dinitrogen tetroxide

6. PCl_3 is named as Phosphorus trichloride

1.11   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 is `https://encrypted-tbn0.gstatic.com/` `images?q=tbn:ANd9GcQCm7h4j6Bfc6g3PhfI2mKHDPc-u6bHMvB5jNimNlpRFFU1Rx5OMBSIBQiCsnYOrtGHs` `usqp=CAU`

$$:\ddot{\ddot{C}}l\text{---}\text{B}\text{---}\ddot{\ddot{C}}l: \qquad\qquad (7) $$
$$ | $$
$$:\ddot{\ddot{C}}l: $$

The lewis structure for $CHCl_3$ is

$$\overset{\displaystyle \text{H}}{\underset{\displaystyle :\ddot{\underset{..}{C}}l:}{:\ddot{\underset{..}{C}}l\!-\!C\!-\!\ddot{\underset{..}{C}}l:}} \tag{8}$$
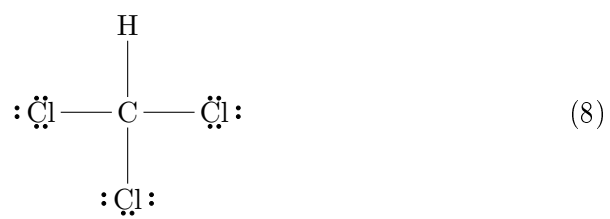
The lewis structure for NCl_3 is

$$\underset{\displaystyle :\ddot{\underset{..}{C}}l:}{:\ddot{\underset{..}{C}}l\!-\!\dot{\ddot{N}}\!-\!\ddot{\underset{..}{C}}l:} \tag{9}$$