1. A molecular compound is composed of 58.8% Xe, 7.2% O, and 34.0% F, by mass. If the molecular weight is 223 amu, what is the molecular formula?

$$58.8\text{ g Xe}\times\frac{1\text{ mol Xe}}{131.29\text{ g Xe}}=0.447864\text{ mol Xe}/0.447864=1$$

$$7.2\text{ g O}\times\frac{1\text{ mol O}}{15.9994\text{ g O}}=0.450017\text{ mol O}/0.447864=1$$

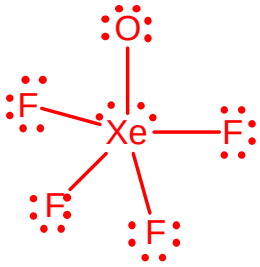
$$34.0\text{ g F}\times\frac{1\text{ mol F}}{18.9984\text{ g F}}=1.78962\text{ mol F}/0.447864=4$$

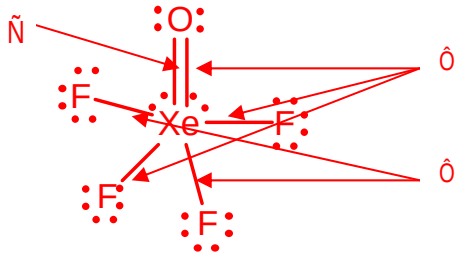
The empirical mass is 223.28 g mol^{-1}.

$$n=\frac{223}{223.28}=1$$

The molecular formula is the same as the empirical formula $XeOF_4$.

2 Draw **TWO** Lewis Structures for the molecule in problem 1. Predict the molecular geometry using the VSEPR model. Describe the bonding, using valence bond theory (hybridization). Label the sigma and pi bonds in your Lewis Structure. Calculate formal charges for all atoms in both structures and explain which structure is most probable.





All bonds here are Ô

The F's are all zero

The Xe is +1 and O is -1

All formal charges here are zero

This is the preferred structure because of the formal charges.

3. Provide formulas or names for the following compounds

a. $K_2Cr_2O_7$

Potassium Dichromate

b. P_4O_{10}

Tetraphosphorus Decoxide

c. Iron(III) Carbonate

$Fe_2(CO_3)_3$

d. Hydrogen Peroxide

H_2O_2

e. H_2SO_3 (aq)

Sulfurous acid

f. Acetic acid

$HC_2H_3O_2$ Ý

4. Balance the following redox equation:

$AuCl_3 + As_2O_3 \rightarrow Au + As_2O_5$ (acid solution)

$6\ H_2O + 4\ AuCl_3 + 3\ As_2O_3 \rightarrow 4\ Au + 3\ As_2O_5 + 12\ H^+ + 12\ Cl^-$

5. A solution is prepared by dissolving 24.5 g of $C_{12}H_{22}O_{11}$ in 355 g of water. Calculate the boiling point, and the osmotic pressure at 25 °C of this solution. Assume the density of the solution is 1.145 g/mL. K_b=0.512 °C/m

$$m = \frac{24.5\text{ g } C_{12}H_{22}O_{11} \times \frac{1\text{ mol } C_{12}H_{22}O_{11}}{342.2965\text{ g } C_{12}H_{22}O_{11}}}{355\text{ g} \times \frac{1\text{ kg}}{10^3\text{ g}}} = 0.2016\text{ m}$$

$$\Delta T_b = K_b m = \left(0.512\ ^\circ\text{C m}^{-1}\right)\left(0.2016\text{ m}\right) = 0.103\ ^\circ\text{C}$$

$$T_b^{'} = T_b + \Delta T_b = 100.000\ ^\circ\text{C} + 0.103\ ^\circ\text{C} = 100.103\ ^\circ\text{C}$$

Find molarity

Assume 1.0000 kg of solvent ∴ 0.2016 mol solute

$$\left(1.0000\text{ kg} \times \frac{10^3\text{ g}}{1\text{ kg}} + 24.5\text{ g}\right) \times \frac{1\text{ mL}}{1.145\text{ g}} \times \frac{1\text{ L}}{10^3\text{ mL}} = .89476\text{ L sol'n}$$

$$M = \frac{0.2016\text{ mol}}{0.89476\text{ L}} = 0.2253\text{ M}$$

$$\Pi = MRT = \left(0.2253\text{ M}\right)\left(62.364\text{ L mmHg mol}^{-1}\text{ K}^{-1}\right)\left(298\text{ K}\right) = 4.19 \times 10^3\text{ mmHg}$$

6. An alloy of iron (71.0%), cobalt (12.0%), and molybdenum (17.0%) has a density of 8.20 g/cm^3. How many cobalt atoms are in a cylinder with a radius of 2.50 cm and a height of 10.0 cm? Volume of a Cylinder = $\pi r^2 h$.

$$? \text{ Co at} = \pi\left(2.50 \text{ cm}\right)^2\left(10.0 \text{ cm}\right)\times\frac{8.20 \text{ g}}{\text{cm}^3}\times\frac{12.0 \text{ g Co}}{100.0 \text{ g}}\times\frac{1 \text{ mol Co}}{58.9332 \text{ g Co}}$$

$$\times\frac{6.022\times10^{23} \text{ atoms Co}}{1 \text{ mol Co}} = 1.97\times10^{24} \text{ atoms Co}$$

7. The molarity of a solution of potassium dichromate can be determined by tiration with potassium iodide solution. In acidic solution, Dichromate ion is reduced to Chromium(III) ion and Iodide is oxidized to Iodine. Write the balanced net ionic and molecular equation for the reaction. What is the molarity of a solution of Potassium Dichromate if 48.5 mL of the solution requires 38.3 mL of 0.500 M Potassium Iodide solution for complete titration?

$$14\ H^+ + K_2Cr_2O_7 + 6\ KI \quad 3\ I_2 + 2\ Cr^{3+} + 7\ H_2O + 8\ K^+$$

Without knowing the acid this is as far as we can go.

$$?\frac{\text{mol } K_2Cr_2O_7}{\text{L}} = \frac{38.3 \text{ mL KI}}{48.5 \text{ mL } K_2Cr_2O_7}\times\frac{0.500 \text{ mol KI}}{1 \text{ L KI}}\times\frac{1 \text{ mol } K_2Cr_2O_7}{6 \text{ mol KI}} = 0.0658 \text{ M}$$

8. The bomb that destroyed the Murrow Federal Office Building in Oklahoma City in 1995 was constructed from ordinary materials: fertilizer (ammonium nitrate) and fuel oil (a mixture of long-chain hydrocarbons, similar to decane, $C_{10}H_{22}$). Determine the enthalpy change of the following explosive reaction using the appropriate heats of formation (¥H_f of $C_{10}H_{22}$ = 249.7 kJ mol^{-1}).

$$3\ NH_4NO_3ß + C_{10}H_{22}à + 14\ O_2Þ \rightarrow 3\ N_2Þ + 17\ H_2OÞ + 10\ CO_2Þ$$

$$\Delta H_{rxn} = \sum_{\text{products}} n\Delta H_f^\circ - \sum_{\text{reactants}} n\Delta H_f^\circ$$

$$= \left[(3)(0.00\text{ kJ}) + (17)(-241.8\text{ kJ}) + (10)(-393.5\text{ kJ})\right]$$

$$-\left[(3)(-365.6) + (1)(249.7\text{ kJ}) + (14)(0.00\text{ kJ})\right]$$

$$= -7199.4\text{ kJ}$$

9. Rhodium has a face-centered cubic structure. The unit cell for Rhodium has an edge length of 3.7900 Angstroms. What is the density of Rhodium?

$$?\ \frac{\text{g}}{\text{cm}^3} = \frac{102.906\ \text{g}}{\text{mol}} \times \frac{1\ \text{mol}}{6.022\times10^{23}\ \text{atom}} \times \frac{4\ \text{atoms}}{\text{cell}} \times \frac{1\ \text{cell}}{\left(3.7900\ \text{Å}\right)^3} \times \frac{\left(1\ \text{Å}\right)^3}{\left(10^{-10}\ \text{m}\right)^3} \times \left(\frac{10^{-2}\ \text{m}}{1\ \text{cm}}\right)^3 = 12.556\ \text{g cm}^{-3}$$

10. Butanol ($C_4H_{10}O$) reacts in the gas phase with Oxygen in the air to produce Carbon Dioxide gas and water vapor. Write the balanced chemical equation for this reaction. If 35.4 mL of Butanol at 26.8°C and a pressure of 867 mmHg reacts with 41.97 mL of Oxygen at 38.3°C and 0.9990 atm, what will be the volume of the products at STP?

$$C_4H_{10}O(g) + 6\ O_2(g) \rightarrow 4\ CO_2(g) + 5\ H_2O(g)$$

$$\frac{\left(35.4\times10^{-3}\ \text{L}\right)\left(867\ \text{mmHg}\right)}{\left(62.364\ \text{L mmHg mol}^{-1}\ \text{K}^{-1}\right)\left(300.0\ \text{K}\right)} \times \frac{9\ \text{mol products}}{1\ \text{mol } C_4H_{10}O} \times \frac{22.414\ \text{L}}{\text{mol}} = 0.331\ \text{L}$$

$$\frac{\left(41.97\times10^{-3}\ \text{L}\right)\left(0.9990\ \text{atm}\right)}{\left(0.082058\ \text{L atm mol}^{-1}\ \text{K}^{-1}\right)\left(311.5\ \text{K}\right)} \times \frac{9\ \text{mol products}}{1\ \text{mol } O_2} \times \frac{22.414\ \text{L}}{\text{mol}} = 0.3309\ \text{L}$$

Both make the same amount of product within the sig figs of the problems so the answers is either one (0.331 L or 0.3309 L).