Name ___________________________

CHEM 0211 (Adv. Inorganic)

Test 1 (10/6)

Fall 2021

1. a. (2 pts.) According to current theories on the universe, subatomic particles and most of the hydrogen nuclei and helium nuclei were formed shortly after what event?

b. (4 pts.) Where and by what nuclear process are hydrogen and helium nuclei converted to nuclei larger than Li.

c. (4 pts.) Nuclei heavier the iron nucleus are not made by the process used in part b. How and where are nuclei heavier than iron formed.

2. (10 pts.) Rutherford's gold foil experiment established what fact about atomic structure, explain.

3. a. (5 pts.) Millikan's oil drop experiment determined what about atomic structure?

b. (5 pts.) Briefly describe how Millikan's experiment was accomplished.

1. _______
2. _______
3. _______
4. _______
5. _______
6. _______
7. _______
8. _______
9. _______
10. ______
11. ______
12. ______

4. (10 pts.) List the possible n, *l,* and m_l values for an electron in each of the following orbitals. If more than one set of quantum numbers can be used to describe the electron, list them all.

a. an electron in a 4d orbital

b. an electron in a 6s orbital

5. (6 pts.) When chemists talk about first molar ionization energies, what reaction are they talking about? Pick and element and write the reaction.

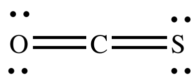
6. (8 pts.) Electron affinity for C is – 122 kJ/mol, whereas the electron affinity for N is 0 kJ/mol This seems odd since N has a more positive nucleus. How can you rationalize the observation that adding and electron to C is more favorable than the adding one to N.

7. (16 pts.) Draw Lewis structures for the following molecules/polyatomic ions.

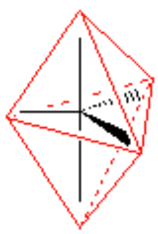
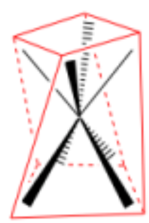
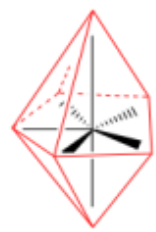
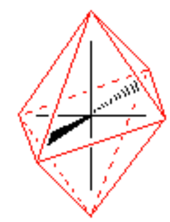
a. $[SO_3]^{2-}$

b. $OPCl_3$

8. a. (4 pts.) Draw two resonance contributors for the molecule that is drawn below.
   b. (4 pts.) Calculate the formal charges for the atoms (label all atoms, even those with a 0 formal charge) in all of the resonance contributors.
   c. (4 pts.) Rank the structures from lowest (#1) to highest (#2, #3) energy.



9. (12 pts.) Some possible arrangements for bonds around a central atom are drawn below. Label each drawing with the appropriate name: tetrahedral, square antiprismatic, pyramidal, bent, v-shaped, trigonal bipyramidal, trigonal planar, pentagonal bipyramidal, octahedral, see-saw, T-shaped.

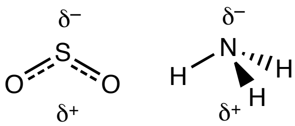
10. (12 pts.) In comparison to the repulsion between pairs of electrons in nonpolar σ bonds, explain how the following features affect the bond angles in a molecule. That is, consider a C–H bond and (i) describe whether the item listed below would require more or less space than a C–H bond, and (ii) describe what the feature would do to other bond angles in the molecule; in other words, would the bonds angles be larger or small than “ideal”.

a. lone pair electrons

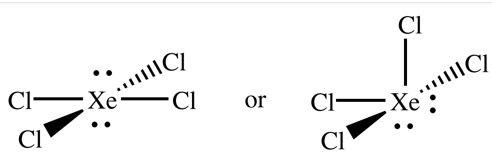
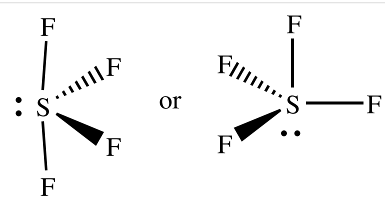
b. π bonds

c. bonds to electronegative atoms

11. (10 pts.) In general chemistry you learned that NH_3 was is a polar molecule. This year you learned that the general chemistry method (a molecule is polar if bond dipoles concentrate opposite charges on opposite sides) is not universally applicable. For example, the dipole in SO_2 is not what the general chemistry method would predict. Describe under what conditions it is safe to use the general chemistry method and when the general chemistry method may lead to the wrong conclusion. (Hint: Draw proper Lewis structures for the compounds below and draw dipole arrows on the polar bonds.)



12. (8 pts. ea.) Determine the three-dimensional shapes of the following molecules and briefly explain your choice (lone pairs not on the central atom have been omitted for clarity).

a.		b.	

1 **H** 1.0079																	2 **He** 4.0026
3 **Li** 6.941	4 **Be** 9.012											5 **B** 10.811	6 **C** 12.011	7 **N** 14.007	8 **O** 15.999	9 **F** 18.998	10 **Ne** 20.1797
11 **Na** 22.989	12 **Mg** 24.305											13 **Al** 26.981	14 **Si** 28.086	15 **P** 30.974	16 **S** 32.065	17 **Cl** 35.453	18 **Ar** 39.948
19 **K**	20 **Ca**	21 **Sc**	22 **Ti**	23 **V**	24 **Cr**	25 **Mn**	26 **Fe**	27 **Co**	28 **Ni**	29 **Cu**	30 **Zn**	31 **Ga**	32 **Ge**	33 **As**	34 **Se**	35 **Br** 79.904	36 **Kr**
37 **Cs**	38 **Sr**	39 **Y**	40 **Zr**	41 **Nb**	42 **Mo**	43 **Tc**	44 **Ru**	45 **Rh**	46 **Pd**	47 **Ag**	48 **Cd**	49 **In**	50 **Sn**	51 **Sb**	52 **Te**	53 **I**	54 **Xe**
55 **Rb**	56 **Ba**	57 **La**	72 **Hf**	73 **Ta**	74 **W**	75 **Re**	76 **Os**	77 **Ir**	78 **Pt**	79 **Au**	80 **Hg**	81 **Tl**	82 **Pb**	83 **Bi**	84 **Po**	85 **At**	86 **Rn**
87 **Fr**	88 **Ra**	89 **Ac**	104 **Rf**	105 **Db**	106 **Sg**	107 **Bh**	108 **Hs**	109 **Mt**	110	111	112		114		116		118

58 **Ce**	59 **Pr**	60 **Nd**	61 **Pm**	62 **Sm**	63 **Eu**	64 **Gd**	65 **Tb**	66 **Dy**	67 **Ho**	68 **Er**	69 **Tm**	70 **Yb**	71 **Lu**
90 **Th**	91 **Pa**	92 **U**	93 **Np**	94 **Pu**	95 **Am**	96 **Cm**	97 **Bk**	98 **Cf**	99 **Es**	100 **Fm**	101 **Md**	102 **No**	103 **Lr**