Name _____ Test 1 (10/4)
CHEM 0211 (Adv. Inorganic) Fall 2023

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? 1. _____

2. _____

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

3. _____

4. _____

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.

5. _____

6. _____

7. _____

2. a. (5 pts.) Bohr's model for an atom treated an electron as what? T'hat is, briefly describe Bohr's model of a hydrogen atom 8. _____

9. _____

10. _____

11. _____

b. (5 pts.) Quantum mechanics models an electron in an atom as what?

12. _____

3. (10 pts.) Rutherford's gold foil experiment established what fact about atomic structure, briefly explain.

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 2s orbital

b. an electron in a 3p orbital

5. (6 pts.) When chemists talk about electron affinity, what reaction are they talking about? Pick and element and write the reaction.

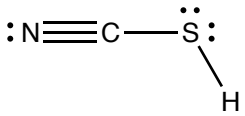
6. (8 pts.) The first molar ionization energy for N is 1402 kJ/mol, whereas it is 1314 kJ/mol for O/ This seems odd since O has a more positive nucleus. How can you rationalize the observation that removing an electron from O is more favorable (easier to do) than the removing one from N.

7. (16 pts.) Draw Lewis structures for the following molecules/polyatomic ions. The central atom is drawn first.

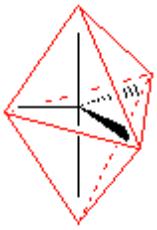
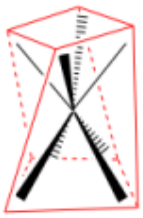
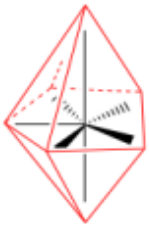
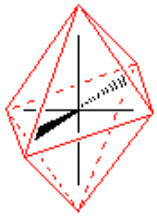
a. $[PCl_3]$

b. $[ClO_3]^-$

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-shape

10. (12 pts.) In comparison to the repulsion between two pairs of electrons in two 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 other bonds angles be larger or smaller than "ideal".

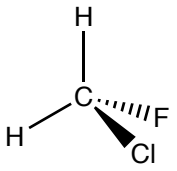
a. lone pair electrons

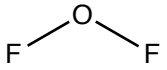
b. π bonds

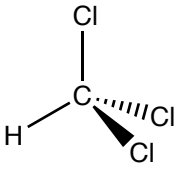
c. bonds to electronegative atoms

11. a. (10 pts.) Draw dipole arrows on the bonds on the molecules drawn below.

b. (10 pts.) Predict the direction of the molecular dipole. If a prediction cannot be confidently made, explain why.

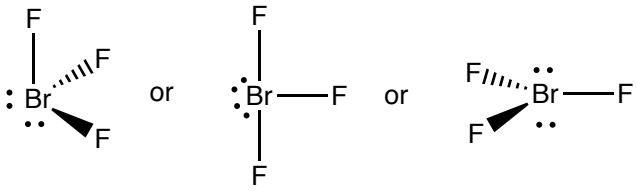




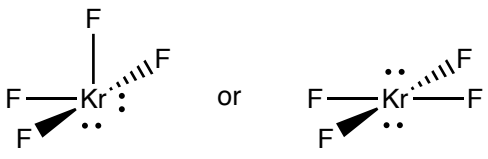


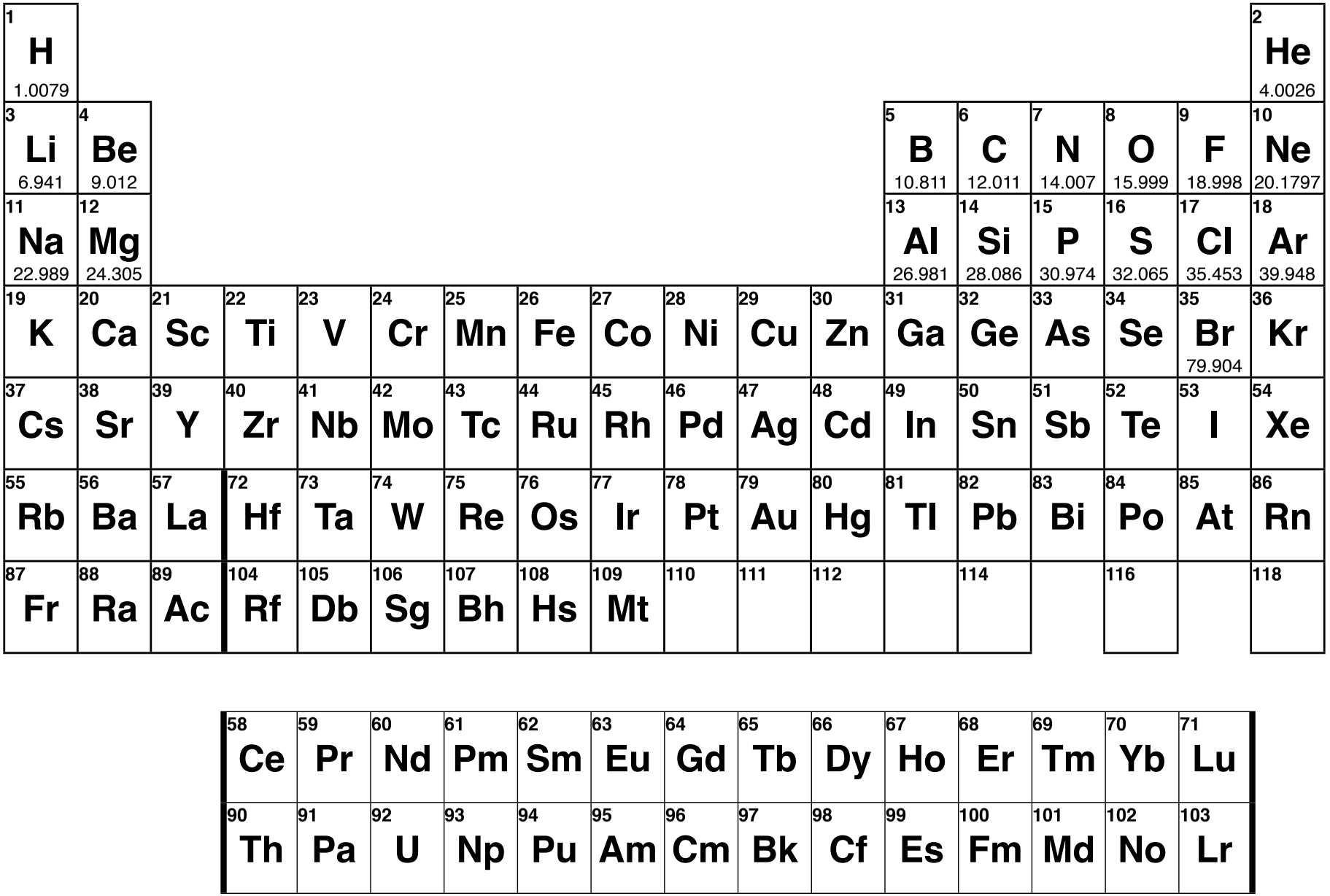
12. (10 pts. ea.) Determine the three-dimensional shapes of the following molecules and briefly explain your choice (lone pairs not on the central atom have been omitted for clarity).

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