CHEM 103
R&R 14
20 June 2024
Adapted from a 24 June 2021 document

1. Arrange the following in order of increasing atomic radius:

a. Ca, Rb, S, Si, Ge, F

b. Be^{2+}, Ca^{2+}, Mg^{2+}, Sr^{2+}

c. Na^{+}, Al^{3+}, Mg^{2+}

d. Cl^{-}, K^{+}, Se^{2-}

e. Cl^{-}, Br^{-}, I^{-}

f. F^{-}, Na^{+}, O^{2-}

2. Rank the following elements in order of increasing electron affinity: Si, F, O, C

3. In each of the following sets, which atom or ion has the smallest first ionization energy?

a. Ba, Ca, Sr

b. Ga, K, Mn

c. F, N, O

d. Ar, Cs, Ge

4. The first ionization energies of As and Se are 0.947 and 0.941 MJ mol^{-1}, respectively. Rationalize these values.

5. What is the maximum number of electrons in an atom that can have the following quantum numbers? Specify the orbitals in which the electrons would be found.

a. $n = 2$, $m_s = +½$

b. $n = 4$, $m_l = 1$

c. $n = 3$, $l = 2$

d. $n = 2$, $l = 0$, $m_s = -½$

e. $n = 4$, $l = 3$, $m_l = -2$

6. Rank the following ions in order of decreasing ionic radii: Na^+, O^{2-}, N^{3-}, Mg^{2+}

What name is given for a set of ions like this?

7. Lithium has a first ionization energy of 520 kJ mol^{-1}. What is the longest wavelength of light that can remove the valence electron from Li?

8. Draw three resonance structures for phosphate.

9. The formula for nitryl chloride is NO_2Cl.

a. Draw the Lewis dot structure for the molecule, including all resonance structures.

b. Describe the electron pair geometry and molecular geometries, and give values for all bond angles.

c. What is the most polar bond in the molecule? Is the molecule polar? Why or why not?

10. Draw the Lewis dot structure for the following compounds and give the total number of electrons.

PBr_3	HNO_3	SCl_2

11. Indicate whether the following compounds contain ionic or covalent bonds. If both bonds are present, write "both." If the compounds contain covalent bonds, draw the Lewis structure of the covalent molecule or polyatomic ion.

$Mg_3(PO_4)_2$	CO_2	$CaSO_4$

12. Predict, using an electronegativity table, which bond in each of the following groups will be the most polar.

a. C—F Ge—F

b. S—F S—Cl S—Br

c. P—Cl S—Cl

d. Ti—Cl Si—Cl Ge—Cl

13. When molten sulfur reacts with chlorine gas, a vile-smelling orange liquid forms that has an empirical formula of SCl. All elements in this compound have a complete octet and a formal charge of 0. Draw the Lewis structure of this compound.

14. Rank the following molecules in the order of increasing polarity:

CH_4, CH_2Cl_2, CH_2F_2, CCl_2F_2, CCl_4, CF_4

15. Fill out the following table:

Molecule	3D Structure	Polar or nonpolar?	Electron pair geometry	Molecular geometry
CH_3CH_2OH				
NBr_3				
CH_2O				
CH_3NH_2				
Nitrite				
Nitrate				
Phosphite				
Phosphate				