

Review #2: Atomic Theory, Periodic Table and Chemical Bonding

1. Define or explain the following terms:

Atom	Alpha-decay	Isoelectronic	Atomic radius
Nucleus	Beta-decay	Halogen	Chemical bond
Proton	Metal	Alkali Metal	Octet Rule
Neutron	Non-metal	Alkaline Earth metal	Ionic Bond
Electron	Metalloid	Noble gas	Non-polar (pure) covalent bond
Atomic Number	Electron configuration	Shielding Effect	Polar covalent bond
Mass Number	Orbital	Net nuclear attraction (Zeff)	Hydrogen bonding
Isotope	Chemical Groups (Families)	Ionization energy	Inter-molecular attraction
Radio-isotope	Chemical Period	Electronegativity	Intra-molecular attraction

2. Complete the following chart:

Element symbol	Atomic Number	Mass Number	Number of Neutrons	Number of Electrons in Neutral Atom	Ionization Reaction	Ion and its charge	Number of Electrons in Ion
Ag		108					
	20		20				
		35		17			
	18		22				
		39	20				
			60	47			
		65		30			
Cu			34				28
	34	79					
		80	45				

3. Referring to the chart in question #2,

- Which atoms and ions are isoelectronic with each other?
- Which atoms and ions are isotopes of one another?

4. What one piece of information about an atom determines its chemical properties?

5. What holds the electrons in an atom close to the nucleus?

6. What happens to the potential energy of an electron when it moves further from the nucleus?

7. One isotope of uranium is "U-238". What does the number represent? How many neutrons does a U-238 atom have?

8. Write electron configurations for neutral atoms of Zn, Ar, Ag and I.

9. List any three ions or atoms that are isoelectronic with a Ca^{2+} ion. Repeat the question for a P^{3-} ion.

10. Use the concepts of net nuclear attraction and shielding effect to explain why:

- atomic radius decreases from left to right across each period on the periodic table
- electronegativity increases from left to right across each period on the periodic table (except for the Noble Gases)
- metals become more reactive down each group
- non-metals become less reactive down each group

11. What are the trends on the Periodic Table for the following characteristics:

- Ionization energy
- Atomic Radius
- Electronegativity
- Reactivity of Metals; Reactivity of Non-metals
- Metallic characteristics (same pattern as reactivity of metals)

12. Complete the following chart comparing the different chemical groups:

Common Name of Group	Alkali Metals	Alkaline Earth Metals	Halogens
Group #			
Elements in the Group			
Number of valence electrons?			
Metals or non-metals?			
What is the last term in the electron configuration?			
Will these elements tend to gain or lose electrons?			
In water, will these elements produce acidic or basic sol'n's			

13. Answer the following questions about quantum levels and electron orbitals:

- a) How is an orbital different from an orbit?
- b) For $n=1$, What is the maximum number of electrons in this principle quantum level? _____
 How many orbitals are there? _____
 How many types of orbitals are there? _____ List them: _____
- c) For $n=2$, What is the maximum number of electrons in this principle quantum level? _____
 How many orbitals are there? _____
 How many types of orbitals are there? _____ List them: _____
- d) For $n=3$, What is the maximum number of electrons in this principle quantum level? _____
 How many orbitals are there? _____
 How many types of orbitals are there? _____ List them: _____
- e) For $n=4$, What is the maximum number of electrons in this principle quantum level? _____
 How many orbitals are there? _____
 How many types of orbitals are there? _____ List them: _____
14. What is the maximum number of electrons that can be designated (held in): 3s _____, 2p _____, 4d _____, 1s _____, 4f _____, 6s _____, 3d _____, 5p _____

15. Write the balanced nuclear reactions to show the:

- a) alpha decay of U – 238
- b) alpha decay of Am-243
- c) beta decay of I-131
- d) beta decay of C-14

16. Canada is proposing to build more nuclear reactors to generate electricity to replace old thermal generating stations that burn coal, oil or natural gas. Give three advantages and three disadvantages of using nuclear reactors.

17. What is the difference in electronegativity (ΔEN) between bonding atoms in:
 ionic bonds _____ non-polar covalent bonds _____ polar covalent bonds _____

18. Complete the following chart for the shapes of covalent molecules:

Shape Code	Name of Shape	Is this SHAPE Symmetrical or Asymmetrical?
AX_2E_0		
AX_3E_0		
AX_2E_1		
AX_4E_0		
AX_3E_1		
AX_2E_2		

19. For each of the covalent compounds below:
- draw their 'stick diagrams' (Lewis structures), including all lone pairs (LP) of electrons
 - write the shape code
 - determine the symmetry of the molecule, considering BOTH its shape and bonded atoms
 - calculate the ΔEN of all bonds
 - considering BOTH the symmetry of the molecule and the polarity of the bonds, determine the overall polarity of the molecule as non-polar, slightly polar or very polar

a) PH_3 b) CO_2 c) CH_2O d) OF_2 e) CH_2Cl_2 f) NSF

20. Referring to the molecules in question 19:

- which compound will have the lowest melting point? Explain why.
- which compound will have the highest melting point? Explain why.
- which compound will be the least soluble in water? Explain why.

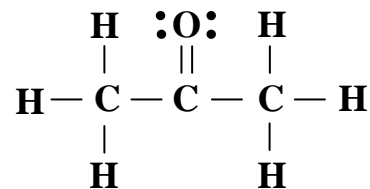
21. Draw the stick diagrams (Lewis structures), including all lone pairs (LP), for the following covalent compounds:

a) C_3H_8 b) N_2H_2 c) HF d) CHOOH e) C_2H_4 f) C_3H_4 g) $\text{C}_2\text{H}_2\text{Cl}_2$

22. Referring to the covalent compounds in questions 19 and 21, write the chemical formulas for all of the compounds that are able to hydrogen bond.

23. A molecule of acetone is drawn to the right.

- Is this molecule symmetrical or asymmetrical?
- Calculate the ΔEN for all bonds.
- Considering BOTH the symmetry of the molecule and the polarity of the bonds, determine the overall polarity of the molecule as non-polar, slightly polar or very polar.
- Label any full or partial charges on the molecule.
- Can this molecule hydrogen bond?
- Predict three physical properties of acetone.



24. Compare the physical properties of acetone (drawn in question 23) and propane (C_3H_8 , drawn in question 21).