Review #1: Atomic Theory and the Periodic Table (Chapter 3)

1. Know the meanings of, and be able to apply, the following terms:

atomic number	excited state	isotope	principal quantum number
atomic radius	ground state	mass number	quantum number
electron configuration	ionization energy	net nuclear attraction (Z_{eff})	shielding effect
electronegativity	isoelectronic	orbital	valence electrons

2. Complete the following table:

Element	Atomic Number	Number of Protons	Number of Electrons	Number of Neutrons	Charge	Mass Number
Fe - 56					3+	
	27		24	31		
			54	76	2–	
Cd -112					2+	

3. Complete the following table:

Element	Atomic Number	Number of Protons	Number of Electrons	Number of Neutrons	Mass Number	Ground State Electron Configuration of Ion	Three (3) Isoelectronic Ions or Atoms
$^{28}_{14}\mathbf{Si}^{4-}$							
$^{80}_{35}\mathbf{Br}^{1-}$							
$^{45}_{21}\mathbf{Sc}^{3+}$							

4. Be able to interpret electron configurations of **neutral** atoms:

Electron Configuration	Group	Period	Element	Common Ion(s)	EN	Atomic Radius	IE_1 (V)	Conducts in pure form?
$[He]2s^2 2p^4$								
$[Kr]5s^2$								
$[Xe]6s^2 4f^{14} 5d^{10} 6p^5$								
$[Ne]3s^2 3p^2$								
$[Xe]6s^1$								

5. Be able to write electron configurations:

a) write the condensed electron configurations for iron, phosphorus, cesium and iodine.

b) write the ***predicted*** condensed electron configurations for chromium, copper, silver and gold.

c) for the elements in question 5b, write the ***actual*** (experimental) electron configurations. Explain why the electrons are arranged in this way.

6. Trends on the Periodic Table:

a) know the trends for first ionization energy, electronegativity, atomic radius, ionic radius

b) be able to **explain** these trends with reference to the concepts of shielding effect and net nuclear attraction (*Zeff*)

i) why is an ion of sodium smaller than a neutral sodium atom

ii) why does electronegativity increase across the periodic table

iii) why is an atom of bromine larger than an atom of fluorine

iv) why is the first ionization energy of sulfur less than that of chlorine

c) be able to interpret successive ionization energies to identify an element:

IONIZATION ENERGIES (eV, electron volts)								# of Valence Electrons	Group # of Element
IE_1	IE_2	IE_3	IE_4	IE_5	IE_6	IE_7	IE_8		
9.3	18.2	153.9	217.7	-	-	-	-		
11.3	24.4	47.9	64.5	392.0	489.8	-	-		
17.4	35.0	62.6	87.2	114.2	157.1	185.1	953.8		
5.1	47.3	71.7	98.9	138.6	172.4	208.4	264.2		
14.5	29.6	47.4	77.5	97.9	551.9	666.8	-		
13.6	35.1	54.9	77.4	113.9	138.1	739.1	871.1		
11.0	19.7	30.2	51.4	65.0	220.4	263.3	309.3		
10.4	23.4	35.0	47.3	72.5	88.0	281.0	328.8		

7. Quantum Mechanics:

a) The number of different types of orbitals when n = 5 is _____.

b) The number of "s" orbitals in the seventh main energy level (n = 7) is _____.

c) The maximum number of electrons that can fit in the third energy level (n = 3) is _____.

d) The number of electrons that can be held in the 5-p orbitals (n = 5) is _____.

e) The number of different types of orbitals when n = 3 is _____.

f) The number of "p" orbitals in the fourth main energy level (n = 4) is _____.

g) The maximum number of electrons that can fit in the fifth energy level (n = 5) is _____.

h) The number of electrons that can be held in the 3-d orbitals (n = 3) is _____.

8. Write the quantum numbers that correspond to each of the following electrons:

Last Electron	n	ℓ	m_ℓ	m_s
$4s^1$				
$3d^9$				
$2s^2$				
$5p^6$				
$1s^1$				
$3p^2$				

9. Which atom or ion is larger:

a) Si, Si^{4+} Si^{4-} or Si^{2+}? Explain.

b) Sb^{3+}, Sb^{5+}, Sb^{3-} or Sb? Explain.