**Module 6:**

1. Ions that are formed from representative elements, IA-VIIA. VIII does not form ions. + ions are cations, - ions are anions.

2. Metals lose electrons when forming ions, nonmetals gain electrons when forming ions. Metalloids normally do not gain or lose electrons. Metals and nonmetals lose or gain electrons to have the same number of electrons (be isoelectronic) with the noble gases. Therefore, IA forms +1, IIA forms +2, IIIA except B form +3 Ga, In and Tl also form +1 or +3 (they are not fixed charge), C in IVA forms -4 but Sn and Pb form either +2 or +4, N and P in VA form -3, O, S and Se in VIA form -2, VIIA form -1.

3. The valence electrons are the electrons in the highest principal energy level, n, of the atom. It is numerically the same as the group number. We only refer to valence electrons when talking about main group (representative) elements, not transition or inner transition elements.

4. When representative elements lose or gain electrons to have the same number of electrons as a noble gas they are said to be isoelectronic with the noble gas. This happens to all of the nonmetals and also to the metals in groups IA, IIA, and Al only. The other main group metals have d electrons that prevent them from being isoelectronic with the previous noble gas.

5. The transition metals (B elements) mostly lose electrons so that more than one positive charged ion (cation) is formed from each element. The exceptions to this are Ag, forms +1, Zn and Cd, form +2.

6. Electron configurations for all of the elements in the periodic table. Remember that IA and IIA are the s region, VA-VIIIA are the p region, the transition metals are the d region, and the inner transition elements are the f region. That means that when you get to that element, using the periodic table as a map, you are adding the additional electron to that sublevel, with the n corresponding to the period number. However, when you get to the d region you are one energy level behind, f region you are two energy levels behind.

7. The exceptions to the electron configurations: Cr and Mo end in s1d5, Cu, Ag and Au end in s1d10 except that Au also has 4f electrons.

8. Electron configurations for ions. For the negative ions electrons are added to the last p and enough are added to end in p6 like a noble gas.

9. Remember that the transitions metals lose from the s first, then the d. The variable charged representative elements lose from the p first then the s.

10. Know that elements in the same group have similar chemical properties (react similarly).

11. Trend in atomic radius (size) is that it increases top to bottom within any group and decreases left to right within any period.

12. Trend in ionization energy (energy needed to remove an electron from an atom) is that it decreases top to bottom within any group and it increases left to right within any period. It is the opposite trend to atomic radius but is related, since the smaller the atom the larger the ionization energy. There are two exceptions: IIIA has less IE than IIA and VIA has less IE than VA. This is because it is very stable to obtain a filled or half -filled sublevel.

13. Wave nature of energy. The distance between crests is the wavelenght, $\lambda$. The number of times per second that a crest travels through a fixed point in space is the frequency, $\nu$. $\nu = c\lambda$ where c is the speed of light, 3.00 x 10 8 m/s. Therefore, when wavelength increases frequency decreases (they are inversely proportional).

14. $E = h\nu$ where h is a constant called Planck's constant. Therefore, energy and frequency are directly proportional, if one increases the other one also increases. If one substitutes $c\lambda$ for $\nu$ then $E = hc/\lambda$ and

this shows that energy and wavelength are inversely proportional. If one increases the other one decreases.

15. Know the order of increasing energy, frequency and wavelength for all of the sections of the electromagnetic spectrum. Note that the order for increasing energy and frequency is the opposite of the order of increasing wavelength. You also need to know this order for the colors, which are what make up the visible region of the spectrum.

16. Know that there is a correspondence between the energy levels in which the elements are in and the period that they are in. Also know the maximum number of electrons in each n (main energy level).

17. Know the sublevels that exist for each energy level, the maximum number of electrons for each and the number of orbitals for each. Remember that each orbital has a maximum of 2 electrons.

18. When two electrons are in the same orbitals they have opposite spins. One is represented with an arrow pointing up, the other one with an arrow pointing down.

19. Know how to do all the different forms of electron configurations: the full electron configuration with the lines for orbitals and arrows for electrons, the shorthand notation and the noble gas abbreviation.

20. Know how to determine if there are any unpaired electrons in an atom. If so the element is paramagnetic. If all of the electrons are paired the atom is diamagnetic. (Group IIA, VIIIA and the last group of the B elements are diamagnetic. The other A and B groups are paramagnetic.