MATRL 100A: Structure and Properties I

Assignment 2, due October 15th in class:

1. Write the electronic configuration of the following elements: Hydrogen, Tritium, Titanium, Cobalt, Gallium, Arsenic, Molybdenum, Tin. Use the long and the short representations. For example, for Li, you would write the long form as $1s^2$, $2s^1$ and the short form as [He]$2s^1$. In all cases, separately indicate which the valence electrons are.

2. Write the electronic configurations of the following ions. Suggest whether the ions are in stable configurations or not: Mg^{2+}, Sc^{3+}, Ti^{3+}, Cr^{3+}, Cr^{6+}, Ga^{3+}, As^{3-}.

3. Of the following binary compounds (between two elements), which are best described as ionically bonded, or covalently bonded. Use the electronegativities of the individual atoms to decide. Also calculate the percentage ionic character of the bonds: MgO, CaO, BeSe, GaBi, CsAu, Si_2, LiI, AgI.

4. What will the likely formulae of the ionic compounds between the following cations and anions be:

	As	Se	Br
Li			
Ag			
Ba			

5. How many moles of water are there in someone who weighs 150 lbs ? Assume that 75% of this person's body weight is water.

6. How many grams of oxygen, sulphur, selenium, or tellurium would you combine with hydrogen to make 0.25 moles of product (water, hydrogen sulphide ...). If a mole of hydrogen molecules at standard temperature and pressure (STP) displaces 22.414 litres, what volume of hydrogen are we talking about ?

7. Variation of problem 2.17 from Callister: The net potential energy E_N between two adjacent ions of opposite charge is expressed in terms of the distance r between them as:

$$E_N = -\frac{C}{r} + D\exp(-\frac{r}{\rho})$$

(a) Verify that the first term on the right is attractive, and the second term is repulsive by making plots of E_N as a function of r separately for the two terms, if C, D, and ρ are positive. You can assume values of 1 for the constants C, D, and ρ. (b) By taking the first derivative of E_N with r and setting it to 0, solve for D in terms of C, ρ, and r_0 (the value of r where the derivative of the energy = 0).