MAE 20
Winter 2011
Assignment 1
Due Thurs., Jan. 13 at the beginning of class

1. **2.8** Potassium iodide (KI) exhibits predominantly ionic bonding. The K^+ and I^- ions have electron structures that are identical to which two inert gases?

2. **2.13** Calculate the force of attraction between a Ca^{2+} and an O^{2-} ion the centers of which are separated by a distance of 1.25 nm.

3. **2.14** The net potential energy between two adjacent ions, E_N, may be represented by the sum of Equations 2.8 and 2.9; that is,

$$E_N = -\frac{A}{r} + \frac{B}{r^n} \qquad (2.11)$$

Calculate the bonding energy E_0 in terms of the parameters A, B, and n using the following procedure:

1. Differentiate E_N with respect to r, and then set the resulting expression equal to zero, since the curve of E_N versus r is a minimum at E_0.
2. Solve for r in terms of A, B, and n, which yields r_0, the equilibrium interionic spacing.
3. Determine the expression for E_0 by substitution of r_0 into Equation 2.11.

4. 2.20 Make a plot of bonding energy versus melting temperature for the metals listed in Table 2.3. Using this plot, approximate the bonding energy for molybdenum, which has a melting temperature of 2617°C.

5. For the HCP crystal structure, show that the ideal c/a ratio is 1.633.

6. Show that the atomic packing factor for BCC is 0.68.

7. Show that the atomic packing factor for HCP is 0.74.

8. Calculate the radius of a palladium atom, given that Pd has an FCC crystal structure, a density of 12.0 g/cm^3, and an atomic weight of 106.4 g/mol.

9. Below are listed the atomic weight, density, and atomic radius for three hypothetical alloys. For each determine whether its crystal structure is FCC, BCC, or simple cubic and then justify your determination. A simple cubic unit cell is shown in Figure 3.23.

Alloy	*Atomic Weight (g/mol)*	*Density (g/cm^3)*	*Atomic Radius (nm)*
A	43.1	6.40	0.122
B	184.4	12.30	0.146
C	91.6	9.60	0.137