

MSEG 201: Introduction to Materials Science, Fall 2024

Homework 1

assigned 8/27

due 9/3 @ 11:59 PM

Please neatly hand write or type your answers to the following questions. Submit a pdf of your solutions to Canvas by 11:59 PM on Tuesday Sept 3.

1 Syllabus Review [2 points]

Please review the syllabus and answer the following questions (a-d):

- Where is Prof. Hewlett's office?
- In order to get an A- in this course, how many HW assignments will have to be at 90% or above?
- If there are, hypothetically, 22 lecture days in the semester, how many lectures do you have to attend to meet the requirement for a B?
- Name any two of the 4 Student Learning Objectives for this course.

2 Bonding Energy [10 points]

The potential energy between two adjacent ions, K^+ and Cl^- , is represented by the sum of the attractive and repulsive energies:

$$E_N = -\frac{1.436}{r} + \frac{5.86 \times 10^{-6}}{r^9}.$$

where E_N is the total energy (in eV) and r is the distance between ion centers (in nm). You can assume that the constants in the equation will give you the correct units.

- Using your favorite plotting software, superimpose E_N , E_A , and E_R as a function of r up to 1.0 nm. Be sure to label the axes as well as each potential energy curve. [4 points]
- Graphically determine the equilibrium spacing and the magnitude of the bonding energy between K^+ and Cl^- . Briefly describe how you determined these values from your plot. [3 points]
- Mathematically calculate the equilibrium spacing and bonding energy, and compare to your graphical results from part (b). [3 points]

3 Miller indices: Directions [4 pts]

Sketch within a cubic unit cell the following crystallographic directions:

- a. $[001]$
- b. $[102]$
- c. $[01\bar{2}]$
- d. $[12\bar{1}]$

4 Miller indices: Planes [4 pts]

Sketch within a cubic unit cell the following crystallographic planes. Be sure to label the origin in your diagram.

- a. (001)
- b. (201)
- c. $(\bar{1}\bar{2}\bar{3})$
- d. $(1\bar{1}\bar{2})$