MSE160 – Molecules and Materials
Problem Set #8- Due February 19th, 2020

1. Describe how plastic deformation occurs in metals in terms of what you've learned in lecture. Begin by thinking about what occurs when a force is applied to a bulk material.

2. Explain at least two limitations of the Hall-Petch equation.

3. Show for a tensile test that the percentage of cold work can be written as shown below if there is no change in the specific volume during deformation ($A_o l_o = A_f l_f$)

$$(\%CW) = \left(\frac{\varepsilon}{\varepsilon + 1}\right) x100$$

4. Below are three sample data sets of yield strengths with their associated material grain size. Which of these three data sets fits the Hall Petch model? In your answer, prove how you have determined this, and calculate the value for $\sigma_o$ and $k_y$

| | Grain size (micron) | Yield stress (MPa) |
|---|---|---|
| Sample 1 | 200 | 100 |
| | 100 | 200 |
| | 50 | 250 |

| | Grain size (micron) | Yield stress (MPa) |
|---|---|---|
| Sample 2 | 250 | 105 |
| | 40 | 180 |
| | 12 | 280 |

| | Grain size (micron) | Yield stress (MPa) |
|---|---|---|
| Sample 3 | 200 | 100 |
| | 45 | 250 |
| | 9 | 290 |