SHOW ALL YOUR CALCULATIONS AND DERIVATIONS TOGETHER WITH THE REFERENCES FOR LITERATURE FROM WHICH DATA ARE TAKEN. IF APPROXIMATIONS ARE MADE IN YOUR CALCULATION, MAKE SURE THAT THIS IS EMPHASIZED IN THE TEXT AND IN YOUR DERIVATIONS. IMPORTANT BEFORE START WORKING ON HW, YOU SHOULD REVIEW THE LECTURES AND SUPPLEMENTAL MATERIALS.

Problem #0
For Au FCC metal with 6.0 \(10^{22}\) atoms/cm\(^3\) and a (100) surface energy of 0.5 eV/atom calculate:
1. Latent heat of sublimation \(\Delta E_s\)
2. Inter-atomic potential energy \(E_b\)

Problem #1.
Consider two metals Co and Fe. The atomic weight of cobalt is \(~59\), (1 mol=59 g), and atomic weight of Fe is \(~57\) (1 mol = 57 g). Calculate the densities of these two elements in g/cm\(^3\) units and make a statement about your result. *Hint: start literature search for lattice parameters of these two elements.*

Problem #2.
Consider the epitaxial room temperature electrodeposition of Cu on Cu(111) at overpotential of \(\eta=1\)V. Find out what should be corresponding growth pressure for the same system in order to achieve the same supersaturation conditions. *Hint: start with literature search for Cu equilibrium pressure at room temperature.*

Problem #3.
Assuming the that heterogeneous nucleation of Ho/Au(111) results in formation of faceted nucleus with only (111) surfaces. Consider following exercise; assume that epitaxy of Ho on Au(111) results in formation of the interface which has the cohesive energy equal to the surface energy of Au(111); \(\gamma_{\text{Au}(111)} = \beta\). Assume that surface energy of Au(111) is twice smaller than the surface energy of Ho(111). Find out at what supersaturation the 2D nucleation of Ho will be expected. *Hint: look for the literature data on \(\gamma_{\text{Au}(111)}\) or use problem #0 data to calculate \(\gamma_{\text{Au}(111)}\).*
Problem #4.
Consider the isotropic (111) surface of FCC solid. If the sublimation energy of this solid is 10 kJ/mol, find out what is the value of surface stress for this solid for (111) surface termination. Hint: Think about surface stress definition, and how the term $\partial \gamma/\partial e$ can be determined.

Problem #5.
If the pseudomorphic monolayer of Ag is deposited on Si(111) wafer, the measured radius of the wafer curvature is determined to be ~20 km. If the Si wafer is 2 mm thick, find the value of the surface stress for Ag. Think about what additional measurement you will need to perform in order to extract the real value of surface energy for Ag independent of the epitaxial strain/stress complications that are encountered in the Ag/Si(111) system. Hint: Look in the literature for the elastic constant for Si, good start is to look for Si wafer manufacturers and their specification of the wafers. Keep in mind that Stoney equation gives you the value of the change in stress.

Problem #6
Find the strain energy density of the icosahedra Au nucleus with ~5 nm radius, shown in Figure left. Find is the value of supersaturation is required for homogenous nucleation of this particle from solution phase. Calculate the number of nuclei in 1 cm$^3$ of solution generated at room temperature in 1 mS time. Hint: make sure you are using appropriate elastic Au constant for this case. E is not appropriate!!!. To find surface energy of Au(111) consult previous problems or literature data.

Problem #7.
Assuming that free surface of the Cu(111) film has a sinusoidal profile, $y=\sin(x)$, find out what is the dependence of the chemical potential of the atoms on the surface on their position. If the Cu(111) film is epitaxial on Au(111) find out what is the difference between the chemical potential of the atoms in position A and B. Find the same for situation of pseudomorphic Au film on Cu(111). Hint: curvature of the surface is given by: $r = \frac{\partial^2 y/\partial x^2}{1 + (\partial^2 y/\partial x^2)^2}$. 