MSE 170 Midterm Study Sheet
Exam Date: Wednesday February 17th, 2010
Exam is closed book, closed notes, closed neighbors. However you can bring one page of notes (one-sided).
Bring calculator and straight edge ruler

- Equations needed, except those listed at bottom, will be given. You need to know what equation to use and what the variables are, e.g. Q is activation energy.
- Sample exams are available on the web page.

This sheet is not comprehensive; there may be questions on the exam not listed below.
Major Topics: Chapters 1 through 8 as per syllabus

Atomic forces (attractive, repulsive, net) vs interatomic distance
Types and magnitudes of bonding forces (Ionic, Covalent, Metallic), and how they affect material properties, i.e. melting point, elastic modulus, ductility, hardness
%ionic character
Force **and** Energy vs Interatomic distance curves for different bond types, equil. atom spacing, r_o

Crystal structures (BCC, FCC); be able to draw, determine # atoms/unit cell, CN#, APF, density
Crystallographic direction and planes; be able to draw and index, arrangement of atoms on plane, linear and planar and volume densities

Defects (point, 1D, 2D, 3D) Vacancies, solid solutions, interstitials, dislocations, grain boundaries, surface and interfacial energy. Be able to describe and draw defects. Calc. equil. # of vacancies, effect of T

Microstructure (single crystal, polycrystal, amorphous): Be able to describe and sketch. Relate to properties (isotropic vs anisotropic) and defects, equiaxed vs. elongated grains, effect of CW

Diffusion: mechanisms, concentration gradients, diffusion coefficients, effect of T, steady state, non-steady state (not math for non-steady state), Ficks first law, diffusion paths (interstitial vs. vacancy, grain boundary, surface), activation energy Q

Mechanical Properties: Definition of stress, strain, modulus, analysis of $\sigma-\varepsilon$ curves, Yield strength, Tensile strength, Poisson's ratio, strain hardening, ductility, elastic recovery, elastic vs. plastic deformation, and hardness, effect of bond strength and type on properties.

Plastic deformation: strain and stress fields around dislocations, direction of dislocation motion (edge vs screw), what determines preferred slip systems, critical resolved shear stress

Dislocations: strain and stress fields, burgers vectors, slip systems, cold working, interaction with impurity atoms, resolved shear stress, strengthening mechanisms, cold working.

Strengthening Mechanisms: Grain size reduction, solid solution hardening and strain hardening/coldworking. Be able to describe and explain how and why strength and ductility change.

Failure: Ductile vs. brittle fracture, ductile-to-brittle transition temperature, creep, fatigue, charpy.

Equations you must have memorized:

$\sigma = F/A,$
$\sigma = E\varepsilon$
$\varepsilon = (l-l_o)/l_o;$
and the equation for planar density