Problem Set #5

1. Describe in detail how you would measure dislocation density using a transmission electron microscope. Your description should include an analysis of errors and problems that would be encountered.

2.a) How could you distinguish between a stacking fault, in a F.C.C. metal on the (111) plane, produced by shear, i.e., R = 1/6 $[11\bar{2}]$, and one produced by condensation of vacancies, i.e., R = 1/3 $[\bar{1}\bar{1}\bar{1}]$.

b) In a faulted dislocation loop (in a F.C.C. metal) of b = 1/3 [111] on (111) a Shockley partial is nucleated and the following reaction occurs

$$1/3\ [111] + 1/6\ [11\bar{2}] \rightarrow 1/2\ [110]$$

Describe the contrast of the loop and the fault before and after the reaction occurred for g = $[2\bar{2}0]$ and g = $[\bar{2}02]$.

3. In a F.C.C. crystal, a dislocation with b = 1/2 $[1\bar{1}0]$ is invisible when imaged using a certain diffraction vector, g. If this dislocation splits into two partials 1/6 $[1\bar{2}1]$ + 1/6 $[2\bar{1}\bar{1}]$ on either side of a stacking fault on (111), described by a fault vector R = 1/3 [111], which of the following are possible.

a) Both partials and fault visible.
b) Both partials and fault invisible.
c) One partial and fault visible.
d) One partial and fault invisible.
e) Both partials visible, fault invisible.
f) Both partials invisible, fault visible.

You need consider the 4 lowest order reflections only.
You may assume that for *partial* dislocations $g \cdot b = \pm 1/3$ produces invisibility and $g \cdot b = +2/3$ produces visibility. For $g \cdot b = -2/3$, dislocations are visible but only at small deviations from the exact Bragg condition.

4. Outline the assumptions made when the kinematical theory of electron diffraction imaging is derived, and hence, describe the conditions for which the theory breaksdown.