Donald P. Shiley School of Engineering EGR 221 Materials Science Assignment 3, Fall 2015

- 1) In Greek, what does the word "piezo" mean? Briefly, what is a piezoelectric material? Briefly describe one engineering application that takes advantage of piezoelectric properties.
- 2) What are carbon nanotubes and what are "*Buckyballs*"? What are their unique properties, and describe a potential application for each.
- 3) Sketch each of the following (be sure to identify the axes):
 a) (1 1 0) b) (1 1 2) c) (0 0 1) d) (1 1 0)



4) Determine the Miller indices for the following planes (be sure to identify the axes):



- 5) Determine the atomic radius of aluminum based on in-class measurements of a Charpy bar. Compare with experimentally determined value of 0.143nm. You may also use any of the following facts. Hint: be sure to use units – they are our friends!
 - a) Aluminum forms FCC crystal structure (APF = 0.74, coordination number = 12, a = $2(2)^{1/2}$ R)
 - b) geometry: $V = (4/3)\pi r^3$, $A = \pi r^2$, $C = 2\pi$
- 6) For the Charpy bar in the previous problem, what is the length of the bar in terms of number of atoms?
- 7) What plane has the highest atomic planar density and what is that density in:
 - a) FCC (hint, it's the basal plane the plane with the hexagonal structure).
 - b) BCC

Remember: since unit cells represent the entire crystal, you need only consider 1 unit cell. But remember, corner atoms and face atoms are shared with adjoining unit cells.

Your answer should be expressed as a percentage of area occupied by "atomic circles."

- 8) What is the direction with highest linear atomic density in:
 - a) FCC and what is that linear density?
 - b) BCC and what is that linear density?

Your answer should be expressed as a percentage of area occupied by "atomic length". Hint, both have a direction with LD of 1 (100%).