

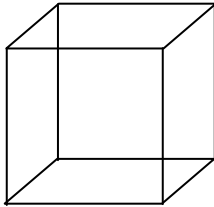
University of Portland
EGR 221 - Materials Science
Exam 1 (CLOSED BOOK, CLOSED NOTES)
September 27, 2013, – **FOR 2015** – blue indicates subject is not on Quiz 1

NAME _____

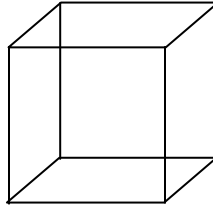
area of a circle = πr^2 , volume of a sphere = $(4/3) \pi r^3$

1) [15 %] Draw the following directions and planes for in the unit cells. **Be clear where the origin is located. Show appropriate steps. Label axes.**

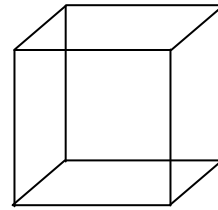
a) $[1 \bar{1} 2]$ direction



b) $(3 \ 0 \ 1)$

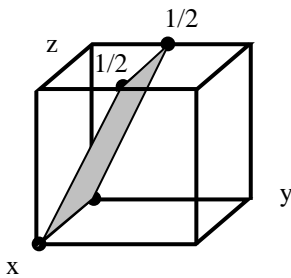


c) $(0 \ 1 \bar{1})$

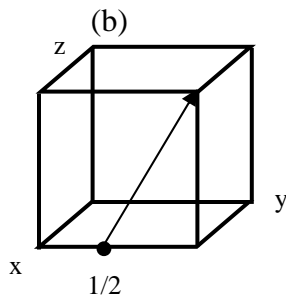


2) [15 %] What are the indices for the following planes and directions? **Show your work** (show the steps). Note, dots (●) indicate where the plane or direction crosses the unit cell. If you choose to “move the origin” – clearly show the new origin location.

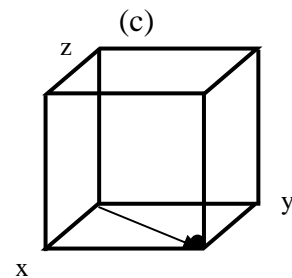
(a)



(b)



(c)



3) [5 %] For BCC, create a 2-dimensional sketch of the (0 0 1) plane and the atoms it contains.

For Problems 4 5, and 6 you MAY include a brief explanation or sketch if you think it would help.

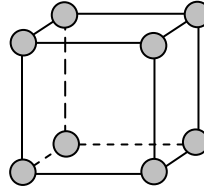
4) [20 %] Fill in the blanks with the correct terms(s).

- A) A material for which the properties **do** depend on direction is referred to as: _____
_____.
- B) A _____ is an example of a point defect (or point imperfection) in a crystal.
- C) Body Centered Cubic (BCC), Face Centered Cubic (FCC), and Hexagonal Close Packed (HCP) are three types of _____ (hint: NOT “unit cells”).
- D) A primary interatomic bond involving the non-directional sharing of non-localized valence electrons (“sea of electrons”) is called: _____.
- E) If carbon atoms (which are relatively small) place themselves within the space between iron atoms in a crystal, this is referred to as: _____ solid solution.

5) [15 pts] Multiple Choice. Pick the single answer in each question that is most correct.

- A) The basic, simplest, unit of a crystal structure is referred to as a
 - a) grain
 - b) unit cell
 - c) lattice
 - d) cubic structure
- B) A special type of grain boundary about which the crystals exhibit symmetry is referred to as (note, these boundaries appear as very straight lines in a photomicrograph):
 - a) crystal boundary
 - b) grain mirror
 - c) grain symmetry
 - d) twin, twin boundary, or twin plane
 - e) polycrystalline line defect
- C) Most metal alloys:
 - a) Are polycrystalline
 - b) Are highly anisotropic
 - c) Are amorphous
 - d) Have BCC crystal structures

- D) The crystal structure shown here is
- a) Face-Centered Cubic (FCC)
 - b) Body-Centered Cubic (BCC)
 - c) Hexagonal Close-Packed (HCP)
 - d) None of the above



- E) The highest linear atomic density (a.k.a. linear density) possible is:
- a) 1 atom / R (200%)
 - b) 1 atom / $2R$ (100%)
 - c) 0.74 atoms / $2R$ (74%)
 - d) None of the above

6) [10 pts] Select the best answer, True or False (T/F).

A) If the atomic radius of a solute atom is much larger than the radii of the solvent it will likely have complete solubility if they have the same crystal structure. **T F**

B) The planar atomic density can never be as high as 1 (100%). **T F**

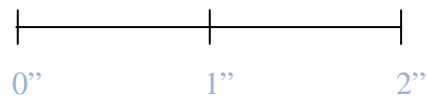
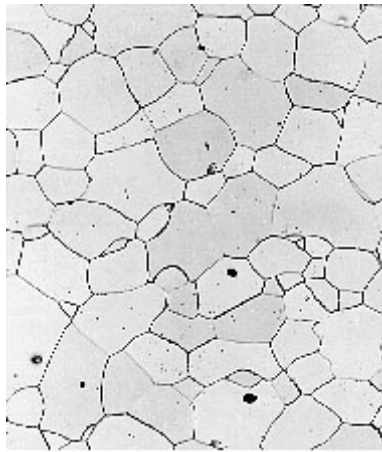
C) For something to be considered an alloy it must contain at least two different elements and at least one of these must be a metallic element. **T F**

D) The coordination number is the ratio of the volume of atoms to the volume of a unit cell. **T F**

E) A mole is a cute fuzzy underground rodent that starred in the movie Caddy Shack. **T F**

Continued on backside...

7) [10 pts] Determine the average grain diameter from the image shown below (100X). Draw 4 lines for your analysis. Show all your work.



8) [10 pts] Sketch (2-dimensionally) to help you describe what is meant by both “substitutional solid solution” and “interstitial solid solution.”