Chemistry 103, Dr. Hamers
WORKSHEET #9 – SOLIDS, PHASE DIAGRAMS
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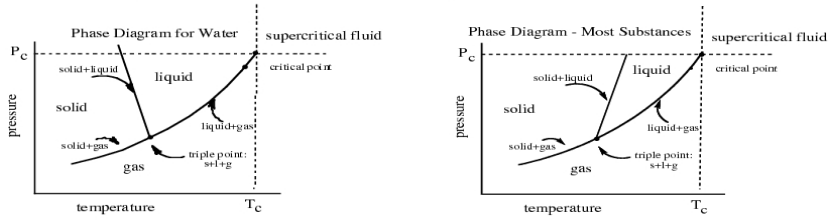
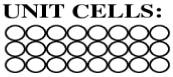
CHAPTER 13
PHASE DIAGRAMS: *Co-existence lines* (*s*+*g*, *s*+*l*, *l*+*g*); Triple Point (*s*+*l*+*g*); *Critical Point*: Above this, a supercritical fluid exists; *Critical Temperature* and *Critical Pressure* – where critical point occurs; *Supercritical fluid*: Density resembles a liquid but viscosity resembles a gas, e.g., CO_2 used to decaffeinate coffee



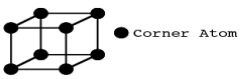
TYPES OF SOLIDS

1. ***Metallic*** (metals) – shiny; thermal and electrical conductors; malleable; ductile; variable bp/mp
2. ***Ionic*** (metal + nonmetal) – brittle; can be cleaved; high bp/mp
3. ***Network*** (nonmetal) - high bp/mp ($C_{graphite}$, $C_{diamond}$, SiO_2 (quartz), Si, Ge)
4. ***Molecular*** (nonmetals) - low bp/mp

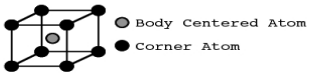
UNIT CELLS:



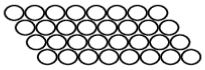
Cubic Packing



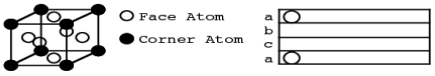
Primitive Cubic (PC)



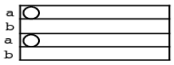
Body-Centered Cubic (BCC)



Closest Packing



Face-Centered Cubic (FCC): *abcabc*



Hexagonal (HEX): *ababab*

Counting Atoms: corner atoms = $^1/_8$; edge atoms = $^1/_4$; face atoms = $^1/_2$; inner atoms = 1

Coordination number (CN; nearest neighbors)**:** number of atoms that touch the atom of interest

UNIT CELL INFO

unit cel	#atoms	CN	packing eff. (%)	side length
PC	1	6	52	2R
BCC	2	8	68	$\frac{4\sqrt{3}}{3}R$
FCC	4	12	74	$2\sqrt{2}R$
HEX	---	12	74	---

$$\textbf{DENSITY} = \frac{\textbf{mass}}{\textbf{volume}} = \frac{\textbf{(\# atoms in unit cell) x (AW/6.022x10}^{23}\textbf{)}}{\textbf{(side)}^3}$$

LATTICE ENERGY: energy that holds an ionic solid together. The energy from the reaction of *individual ions* in the *gas phase* forming **1 mol** of an *ionic solid*. CaO: $Ca^{+2}(g) + O^{-2}(g) \rightarrow CaO(s)$

Changes to LE: ionic charges ↑ or ionic radii ↓ ⇒ LE ↑ ⇒ melting/boiling point ↑