Lecture 12

Tuesday, October 22, 2024 10:09

Topic 4A: Phase Diagrams of Pure Substances

Phase: a form of matter that is uniform throughout in chemical composition and physical state

e.g. $H_2O(l)$ vs. $H_2O(s)$

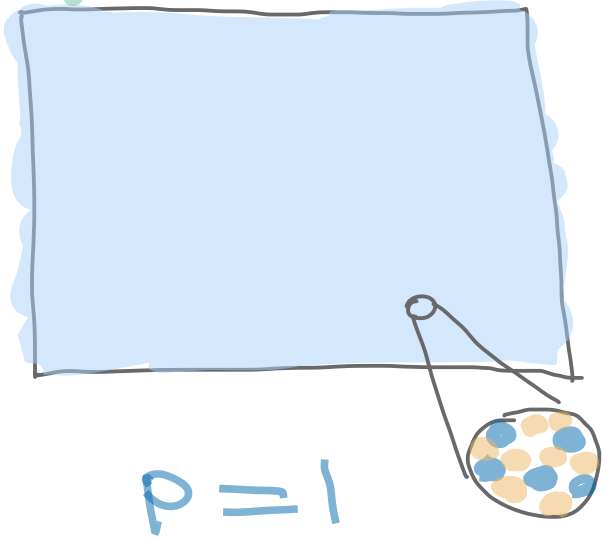
C(graphite) vs. C(diamond)

allotrope: a particular molecular form of an element; may be solid, liquid, or gas. E.g. O_2 vs. O_3

polymorph: one of a number of solid phases of an element or compound. E.g. α-$Ni(OH)_2$ vs. β-$Ni(OH)_2$

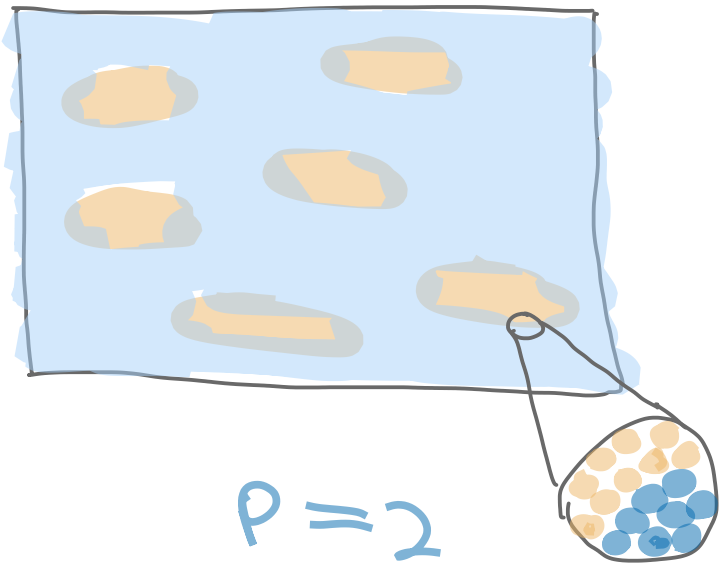
Denote with symbol P

single-phase solution



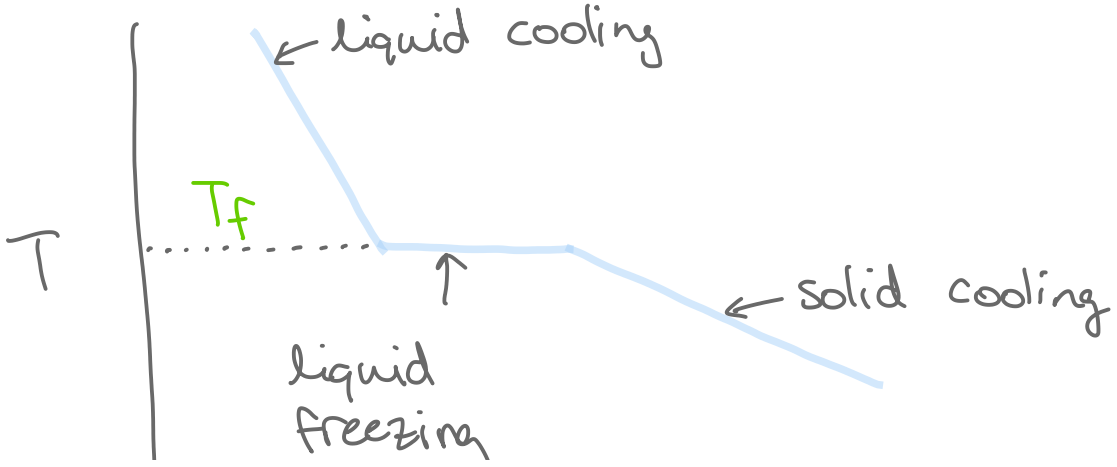
P = 1

dispersion



P = 2

Phase Transitions: a spontaneous conversion of one phase into another phase. Occurs at a characteristic transition temperature T_{trs} for a given pressure.



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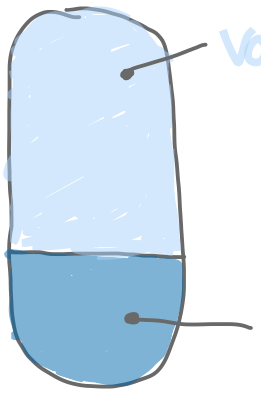
Thermodynamic criteria of phase stability

chemical potential $\mu = G_m$

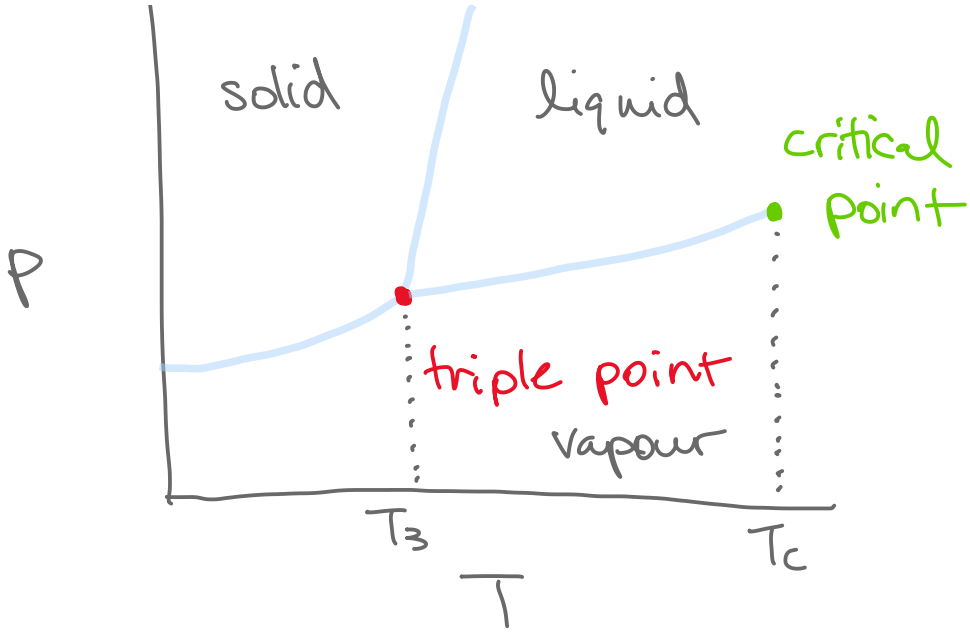
(for a single substance)

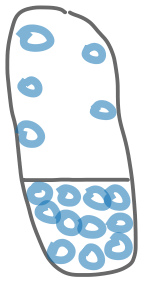


at equilibrium,

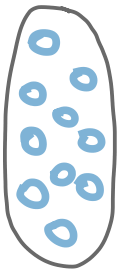
$\mu_1 = \mu_2$

At equilibrium, the chemical potential of a substance is the same in and throughout every phase present in the system.





liquid and vapour



supercritical fluid

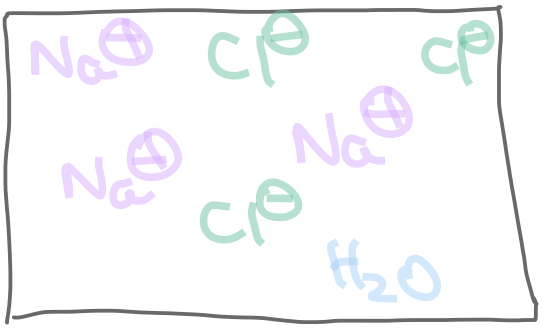
Phase Rule

Number of degrees of freedom (F):

number of intensive variables that can be changed independently without disturbing the number of phases in equilibrium.

Constituent: any chemical species present

Component (C): a chemically independent constituent of a system.



3 constituents, but only 2 components

$n(Na^{\oplus})$ is fixed by $n(Cl^{\ominus})$

Case 1: only one component is present.

$P = 1 : F = 2$

$P = 2 : \mu(\alpha; p, T) = \mu(\beta; p, T)$

p must change if T changes (in general)

F = 1