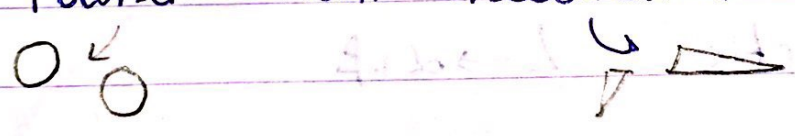


## Chapter 10 :- Dispersion Strengthening and Eutectic phase Diagrams

### Effective Dispersion Strengthening :-

- (a) The precipitate should be hard & discontinuous
- (b) The dispersed phase particles should be small & numerous
- (c) ~ ~ ~ ~ ~  
~ round than needlelike  

- (d) large amounts of dispersed phase increase strengthening

# • Stoichiometric & non stoichiometric intermetallic compound

∴ Page 17 Slides

- Stoichiometric  $\rightarrow$  appears as a vertical line in some phase diagrams  $\rightarrow$  have one fixed composition
- Non stoichiometric  $\rightarrow$  have a range of compositions

## \* Three phase Reactions

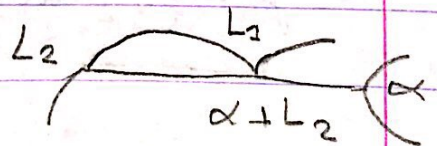
Eutectic  $L \rightarrow \alpha + \beta$



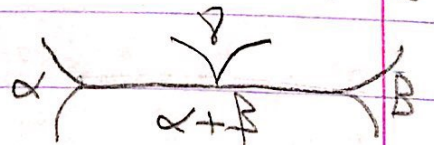
Peritectic  $\alpha + L \rightarrow \beta$



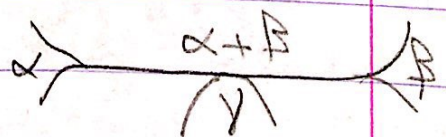
Monotectic  $L_1 \rightarrow L_2 + \beta$



Eutectoid  $\gamma \rightarrow \alpha + \beta$



Peritectoid  $\alpha + \beta \rightarrow \gamma$



↙ Easy to melt

## The Eutectic Phase Diagram

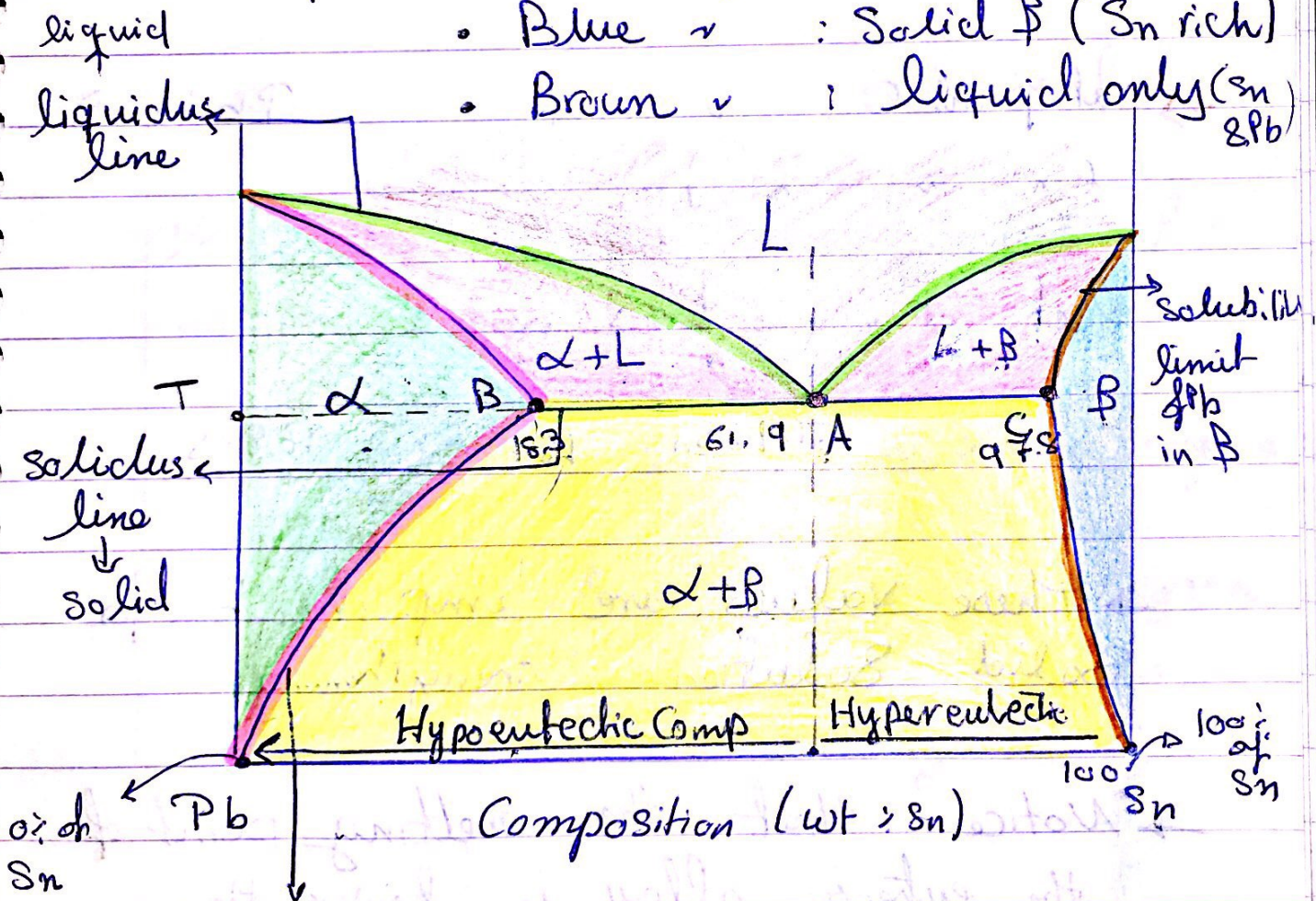
Importance: It Gives a present phase in a given Temp & pressure, Chemical comp of phases, and phase weight fraction.

Example :-

- Green Region: Solid  $\alpha$  (Pb rich)

- Blue  $\checkmark$  : Solid  $\beta$  (Sn rich)

- Brown  $\checkmark$  : liquid only (Sn & Pb)



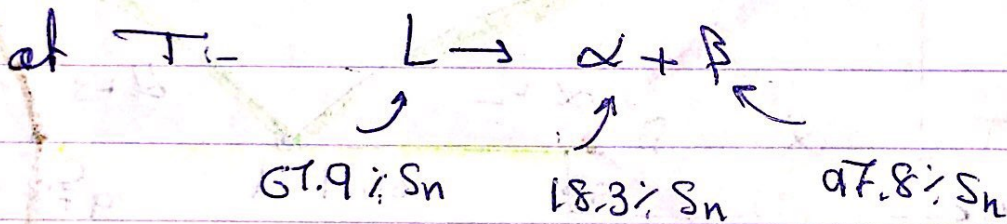
solubility limit of Sn in  $\alpha$

- purple and red Regions: Slush (mix of solid  $\alpha, \beta$  and liquid L)

→ at point A: The eutectic Reaction occurs and  $T$  is the eutectic Temp ( $C_E$  : eutectic concentration)

→ at point B: Max solubility of Sn in  $\alpha$  (on the x-axis)

→ at point C:  $\alpha$   $\leftrightarrow$   $\beta$   $\leftrightarrow$  Pb in  $\beta$   
( $\alpha$   $\leftrightarrow$   $\beta$   $\leftrightarrow$ )

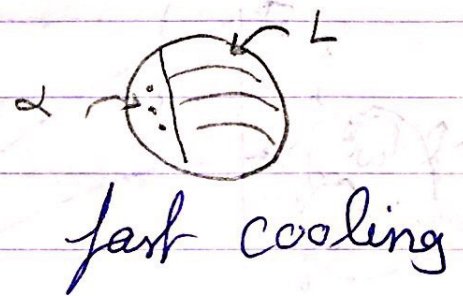


→ These values are important for Solid Solution Strengthening

→ Notice that the melting point of the eutectic alloy is lower than that of the components that's why we call it Easy to melt

→ There is no complete melting  
(not isomorphous)

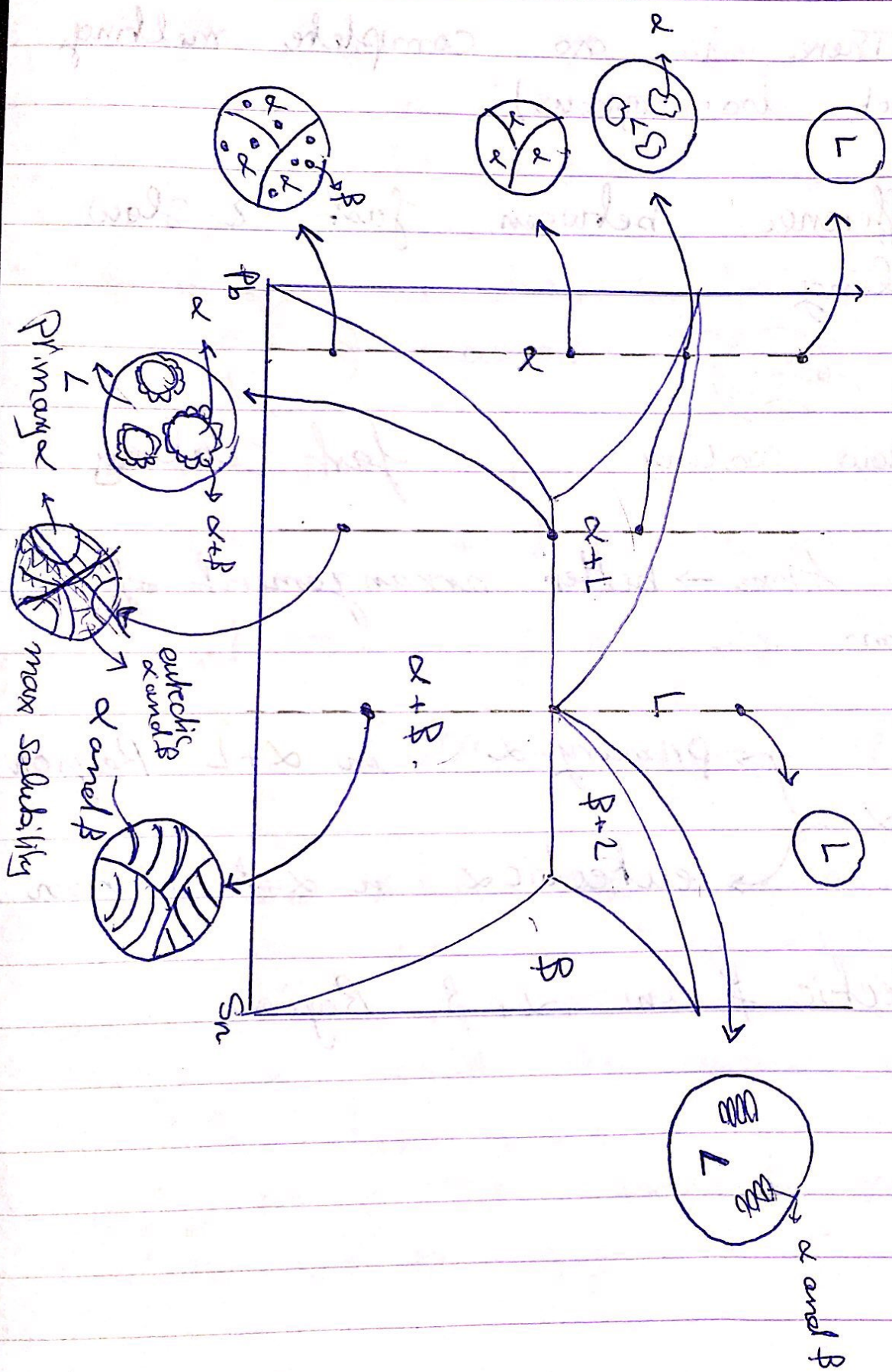
→ Difference between fast & slow  
Cooling



More time → better arrangement of  
atoms

$\alpha$  → primary  $\alpha$  in  $\alpha + L$  Region  
→ eutectic  $\alpha$  in  $\alpha + \beta$  Region

eutectic  $\beta$  in  $\alpha + \beta$  Region



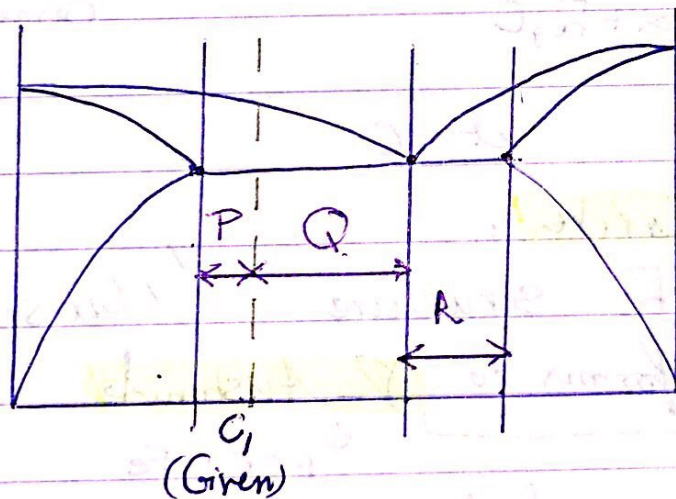
## Lever Rule for eutectic Reaction

$$W_{\alpha_1} = \text{percent of primary } \alpha = \frac{Q}{P+Q}$$

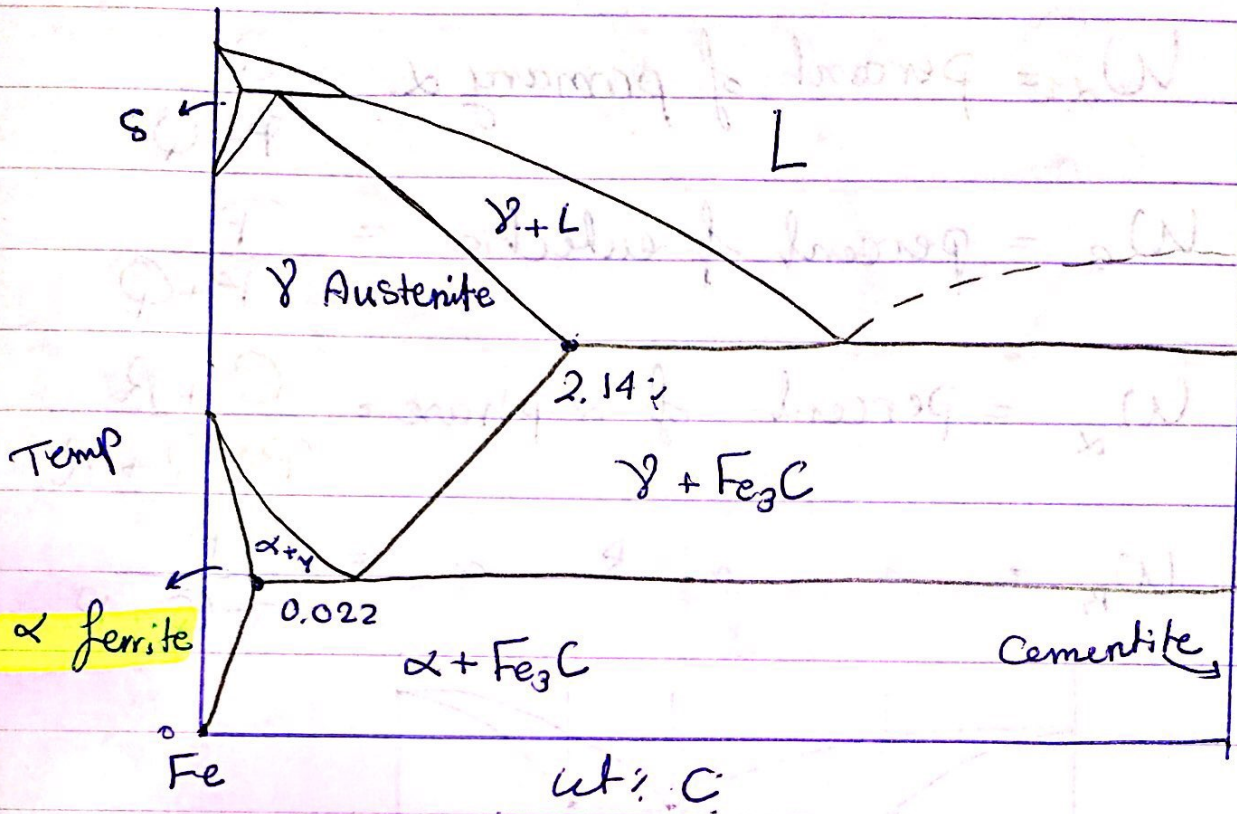
$$W_e = \text{percent of eutectic} = \frac{P}{P+Q}$$

$$W_{\alpha} = \text{percent of } \alpha\text{-phase} = \frac{Q+R}{P+Q+R}$$

$$W_{\beta} = \text{percent of } \beta\text{-phase} = \frac{P}{P+Q+R}$$



# Fe-Fe<sub>3</sub>C phase diagram



## $\alpha$ Ferrite :

- ↳ BCC Fe structure / Max sol of C = 0.025
- ↳ transforms to  $\gamma$ -Austenite at  $T = 912^\circ\text{C}$ 
  - ↓ FCC Fe
- ↳ Max solubility of C in it = 2.14
- ↳  $\gamma$ -Austenite transforms to BCC  $\delta$  ferrite at  $1395^\circ\text{C}$ 
  - ↓ melts at  $1538^\circ\text{C}$

Fe<sub>3</sub>C : intermetallic compound  
 ↓  
 cementite / iron carbide



## • Strength of Eutectic alloys

We can control it by:-

- 1- Eutectic Colony size
- 2- interlamellar spacing
- 3- Amount of Eutectic
- 4- Microstructure of the Eutectic