

Answer Keys (Fall 2023-24)

CAT-II (BMEE209L)

1.

Alloy - Hyper-eutectic.

$$W_{\text{pro-}\beta} = 0.5$$

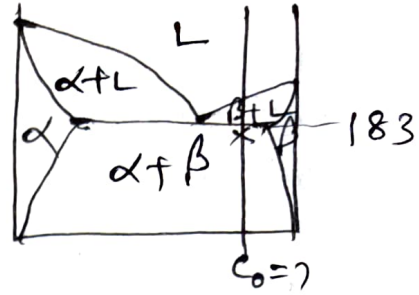
$$W_{\text{pro-}\beta} = 0.5 = \frac{C_0 - C_L}{C_\beta - C_L}$$

$$0.5 = \frac{C_0 - 62}{98 - 62}$$

$$\Rightarrow C_0 - 62 = 0.5 \times 36$$

$$\Rightarrow C_0 - 62 = 18$$

$$C_0 = 80\% \text{ Sn} - 20\% \text{ Pb}$$



T = just below eutectic temp.

$$W_{\text{pro-}\beta} = 0.5 \quad / \quad W_{\text{eut}(\alpha+\beta)} = 0.5$$

$$W_{\text{total-}\beta} = W_{\text{pro-}\beta} + W_{\text{eut-}\beta}$$

$$W_{\text{total-}\beta} = \frac{C_0 - C_\alpha}{C_\beta - C_\alpha} = \frac{80 - 18}{98 - 18} = \frac{62}{80} = 0.775$$

$$W_{\text{eut-}\beta} = 0.275$$

$$W_{\text{eut-}\alpha} = 1 - 0.775 = 0.225$$

2 (a)

(b)



Hypo-



pearlite



pearlite
primary Fe₃C
along the grain boundaries

3.

(a) (i) 50% FP + 50% UB

(ii) 50%B + 50%M

(iii) 50% LB + 50% M

(iv) 50% P + 50% M

(v) 100% CP

(b)

Quench baths

(i) 680°C / ~~570°C~~ 380°C / 28°C

(ii) 680°C / ~~28°C~~ 28°C

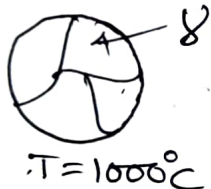
(iii) 550°C / 28°C

(iv) ~~28°C~~ 28°C

(v) Not possible

4)

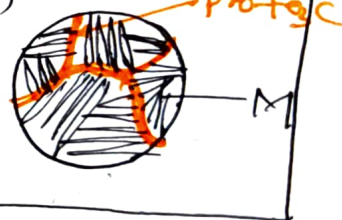
(i)



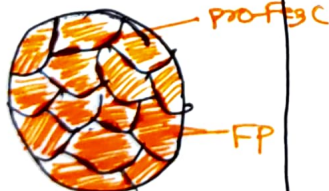
(ii)



(iii)



(iv)



(v)

ii > iii > iv

5

(a)

Hyper eutectoid steel

Normalizing

Austenitization (A_{cm} + 50°C)

- Grain refinement
- need more
- to avoid continuous Fe₃C network along the grain boundary

Annealing

in bath

A₁ & A_{cm}

- to avoid continuous Fe₃C network along the grain boundary

(b)