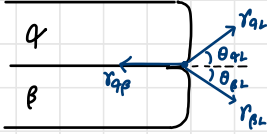


# HW#6

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1 (a)



$$r_{qb} = r_{qL} \cos \theta_{qL} + r_{pL} \cos \theta_{pL} \dots (1)$$

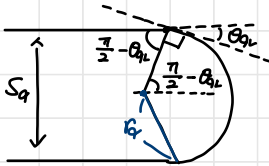
$$r_{qL} \sin \theta_{qL} = r_{pL} \sin \theta_{pL} \dots (2)$$

Case 1) If the layer tip doesn't have curvature,  $\theta_{qL} = \theta_{pL} = 90^\circ$

by eqn. (1)  $r_{qb} = r_{qL} \cdot 0 + r_{pL} \cdot 0 = 0 \Rightarrow$  impossible.

$\therefore$  Each layer has a curvature

(b)



$$S_q = z r_a \cos \theta_{qL} \quad S_p = z r_b \cos \theta_{pL}$$

$$r_{qL} \sin \theta_{qL} = r_{pL} \sin \theta_{pL}$$

$$\Rightarrow r_{qL}^2 \sin^2 \theta_{qL} = r_{pL}^2 \sin^2 \theta_{pL}$$

$$\Rightarrow r_{qL}^2 (1 - \cos^2 \theta_{qL}) = r_{pL}^2 (1 - \cos^2 \theta_{pL})$$

$$\Rightarrow \cos \theta_{pL} = \sqrt{\frac{r_{qL}^2 - r_{qL}^2 \cos^2 \theta_{qL} + r_{pL}^2 \cos^2 \theta_{qL}}{r_{pL}^2}}$$

$$\therefore r_{qb} = r_{qL} \cos \theta_{qL} + r_{pL} \sqrt{\frac{r_{qL}^2 - r_{qL}^2 \cos^2 \theta_{qL} + r_{pL}^2 \cos^2 \theta_{qL}}{r_{pL}^2}}$$

$$\Rightarrow r_{qb} = r_{qL} \frac{S_q}{2r_a} + \sqrt{r_{pL}^2 - r_{qL}^2 + r_{qL}^2 \frac{S_q^2}{4r_a^2}}$$

$$\Rightarrow r_{pL}^2 - r_{qL}^2 + r_{qL}^2 \frac{S_q^2}{4r_a^2} = r_{qb}^2 + r_{qL}^2 \frac{S_q^2}{4r_a^2} - 2r_{qb} r_{qL} \frac{S_q}{2r_a}$$

$$\Rightarrow \frac{1}{r_a} = \frac{r_{qb}^2 - r_{pL}^2 + r_{qL}^2}{S_q r_{qb} r_{qL}} \Rightarrow r_q = \frac{S_q r_{qb} r_{qL}}{r_{qb}^2 - r_{pL}^2 + r_{qL}^2}$$

$$\therefore r_p = \frac{S_q r_{qb} r_{pL}}{r_{qb}^2 - r_{qL}^2 + r_{pL}^2}$$

$\overline{\overline{\uparrow}}$   
same way of  $r_q$

(c) Cylinder  $\Rightarrow$  Capillary effect :  $\frac{r}{s} \Delta m$

$$\begin{aligned}\Delta G_{\text{capillary}} &= \frac{\gamma_{qL}}{r_q} V_q + \frac{\gamma_{pL}}{r_p} V_p \\ &= \frac{V_q (\gamma_{q\theta}^2 + \gamma_{qL}^2 - \gamma_{pL}^2)}{s_q r_{qp}} + \frac{V_p (\gamma_{p\theta}^2 + \gamma_{pL}^2 - \gamma_{qL}^2)}{s_p r_{qp}}\end{aligned}$$

Assume that  $\frac{V_q}{s_q} = \frac{V_p}{s_p} = \frac{V_m}{s}$

$$\Delta G_{\text{capillary}} = \frac{2r_{qp} V_m}{s} = \Delta G_{\text{IF}}(s)$$