

3.6

$$C_D = C_{Dm} + K_m (C_L - C_{Lm})^2$$

$$E = \frac{C_L}{C_{Dm} + K_m (C_L - C_{Lm})^2}$$

$$\frac{dE}{dC_L} = 0 \Rightarrow [C_{Dm} + K_m (C_L - C_{Lm})^2] \cdot 1 - C_L [2K_m (C_L - C_{Lm}) \cdot 1] = 0$$

$$C_{Dm} + K_m C_L^2 - 2K_m C_{Lm} C_L + K_m C_{Lm}^2 - 2K_m C_L^2 + 2K_m C_{Lm} C_L = 0$$

$$C_{Dm} - K_m C_L^2 + K_m C_{Lm}^2 = 0$$

$$* C_L = \sqrt{\frac{C_{Dm} + K_m C_{Lm}^2}{K_m}} = C_{L_{Emax}}$$

$$E_{max} = \frac{\sqrt{\frac{C_{Dm} + K_m C_{Lm}^2}{K_m}}}{C_{Dm} + K_m \left[\sqrt{\frac{C_{Dm} + K_m C_{Lm}^2}{K_m}} - C_{Lm} \right]^2}$$

$$\begin{aligned} \text{Denom} &= C_{Dm} + C_{Dm} + K_m C_{Lm}^2 - 2K_m C_{Lm} \sqrt{\frac{C_{Dm} + K_m C_{Lm}^2}{K_m}} + K_m C_{Lm} \\ &= 2C_{Dm} + 2K_m C_{Lm}^2 - 2K_m C_{Lm} \sqrt{\frac{C_{Dm} + K_m C_{Lm}^2}{K_m}} \end{aligned}$$

$$\begin{aligned} E_{max} &= \frac{\sqrt{\frac{C_{Dm} + K_m C_{Lm}^2}{K_m}}}{2K_m \left(\frac{C_{Dm} + 2K_m C_{Lm}^2}{K_m} \right) - 2K_m C_{Lm} \sqrt{\frac{C_{Dm} + K_m C_{Lm}^2}{K_m}}} \\ &= \frac{1}{2K_m \sqrt{\frac{C_{Dm} + 2K_m C_{Lm}^2}{K_m}} - 2K_m C_{Lm}} \end{aligned}$$

$$* E_{max} = \frac{1}{2 \sqrt{K_m (C_{Dm} + 2K_m C_{Lm}^2)} - 2K_m C_{Lm}}$$

$$\text{For } C_{Lm} = 0 \quad C_{L_{Emax}} = \sqrt{\frac{C_{Dm}}{K_m}} \quad E_{max} = \frac{1}{2 \sqrt{C_{Dm} K_m}}$$