5.1 $\quad L = W \Rightarrow V = \sqrt{\dfrac{2W}{\rho S_w C_L}} \qquad C_L = \text{Const.}$

$$-\frac{dx}{dW} = \frac{V}{cD} = \frac{E(C_L)}{c}\sqrt{\frac{2}{\rho S_w C_L}}\frac{1}{\sqrt{W}}$$

$$x_f - x_0 = \frac{2E(C_L)}{c}\sqrt{\frac{2}{\rho S_w C_L}}\left(\sqrt{W_0} - \sqrt{W_f}\right)$$

$$-\frac{dt}{dW} = \frac{1}{cD} = \frac{E(C_L)}{c}\frac{1}{W}$$

$$t_f - t_0 = \frac{E(C_L)}{c}\ln\left(\frac{W_0}{W_f}\right)$$

$$\max \frac{E}{\sqrt{C_L}} = \max \frac{\sqrt{C_L}}{C_{D0} + K C_L^2}$$

$$\frac{d}{dC_L}(\,) = 0 \qquad (C_{D0} + K C_L^2)\frac{1}{2\sqrt{C_L}} - \sqrt{C_L}\, 2K C_L = 0$$

$$C_{D0} + K C_L^2 - 4 K C_L^2 = 0 \Rightarrow C_L = \frac{1}{\sqrt{3}}\sqrt{\frac{C_{D0}}{K}} = \frac{C_L^*}{\sqrt{3}}$$

$$\left(\frac{E}{\sqrt{C_L}}\right)_{max} = \frac{\dfrac{1}{3^{1/4}}\dfrac{C_{D0}^{1/4}}{K^{1/4}}}{C_{D0} + K\dfrac{C_{D0}}{3K}} = \frac{3^{3/4}}{4K^{1/4}C_{D0}^{3/4}}$$

$$\max E \qquad C_L = C_L^* \qquad \frac{E}{\sqrt{C_L}} = \frac{E^*}{\sqrt{C_L^*}} = \frac{\left(\dfrac{C_{D0}}{K}\right)^{\frac{1}{4}}}{C_{D0} + K\dfrac{C_{D0}}{K}}$$

$$\frac{E^*}{\sqrt{C_L^*}} = \frac{1}{2C_{D0}^{3/4}K^{1/4}}$$

$$\frac{\dfrac{E^*}{\sqrt{C_L^*}}}{\left(\dfrac{E}{\sqrt{C_L}}\right)} = \frac{\dfrac{1}{2C_{D0}^{3/4}K^{1/4}}}{\dfrac{3^{3/4}}{4C_{D0}^{3/4}K^{1/4}}} = \frac{2}{3^{3/4}} = 0.877$$

$$1 - 0.877 = 0.123 = 12.3\%$$