where the diffusion time is given by:

$$t_\text{d} = \frac{h_\text{m}^2}{D_\text{m}} \tag{2.10}$$

It should be noted that as the exponent of a very large negative number approaches zero, the summation term in Equation (2.9) can be ignored at long times so that Equation (2.9) reduces to the form of Equation (2.1):

$$Q(t) = K_\text{m} A C_\text{v} h_\text{m}\left(\frac{D_\text{m} t}{\text{h}_\text{m}^2} - \frac{1}{6}\right) = k_\text{p} A C_\text{v}\left(t - \frac{h_\text{m}^2}{6D_\text{m}}\right) = k_\text{p} A C_\text{v}(\text{t} - \text{lag}) \tag{2.11}$$

where lag is given by:

$$\text{lag} = \frac{h_\text{m}^2}{6D_m} = \frac{t_\text{d}}{6} \tag{2.12}$$

Given the advent of numerical fast inverse Laplace transforms (FILTs) [4–6] with nonlinear regression modeling, we would normally analyze cumulative amount vs. time data numerically, inverting from the Laplace domain using Equation (2.13), where s is the Laplace variable:

$$\hat{Q}(s) = -D_\text{m} A \frac{1}{s}\frac{\partial \hat{C}_\text{m}}{\partial x}\bigg|_{x=h_\text{m}} = \frac{k_\text{p} A C_\text{v}}{s^2}\frac{\sqrt{st_\text{d}}}{\sinh\sqrt{st_\text{d}}} \tag{2.13}$$

Figure 2.3 shows a plot of the cumulative amount penetrated for the diffusion [Eq. (2.13), curve 2] and steady-state [Eq. (2.11), curve 1] models versus time. Equation (2.9) or (2.13) can be used to analyze in vitro experimental data by nonlinear regression, as shown in Figure 2.4.

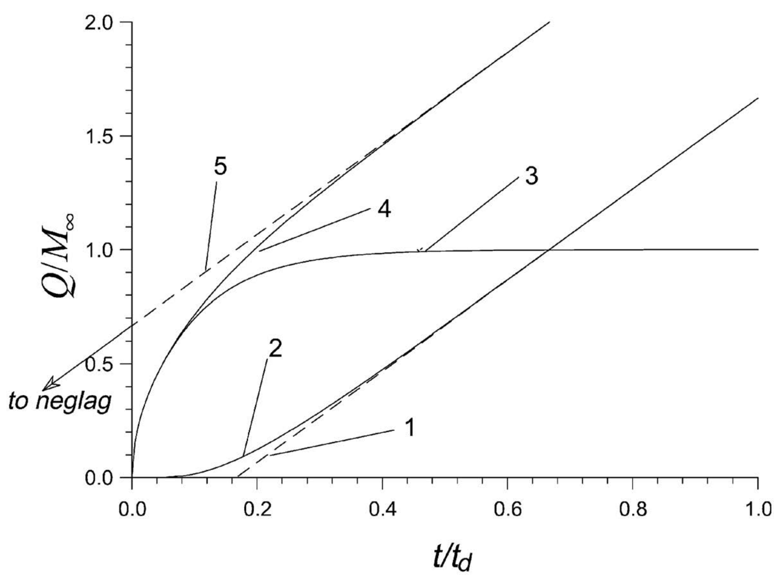

FIGURE 2.3 Normalized cumulative amount of solute penetrating Q/M_∞ [curve 2, Equation (2.13)]; taken up by the SC [curve 3, Equation (2.15)]; and leaving vehicle [curve 4, Equation (2.18)] with normalized time. Curves 1 and 5 represent steady-state approximations of the cumulative amount penetrating the SC [Equation (2.11)] and leaving the vehicle [Equation (2.17)] with normalized time.