Delphine’s handy dandy units and formula sheet

**DIFFUSION**

Important Quantities and their units:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$x$</td>
<td>position</td>
<td>[cm]</td>
</tr>
<tr>
<td>$t$</td>
<td>time</td>
<td>[sec]</td>
</tr>
<tr>
<td>$c(x,t)$</td>
<td>concentration</td>
<td>$[\text{mole/cm}^3]$</td>
</tr>
<tr>
<td>$\phi$</td>
<td>diffusive flux</td>
<td>$[\text{mole/sec \cdot cm}^2]$</td>
</tr>
<tr>
<td>$D$</td>
<td>diffusivity</td>
<td>$[\text{cm}^2/\text{sec}]$</td>
</tr>
<tr>
<td>$k$</td>
<td>partitioning coefficient</td>
<td>[unitless]</td>
</tr>
<tr>
<td>$P$</td>
<td>permeability</td>
<td>$[\text{cm/sec}]$</td>
</tr>
<tr>
<td>$\tau_{SS}$</td>
<td>steady state time constant</td>
<td>[sec]</td>
</tr>
<tr>
<td>$\tau_{EQ}$</td>
<td>equilibrium time constant</td>
<td>[sec]</td>
</tr>
</tbody>
</table>

General Equations:

\[
\phi(x,t) = -D \frac{\partial}{\partial x} (c(x,t)) \quad \text{Fick’s First Law}
\]

\[-\frac{\partial}{\partial x} \phi(x,t) = \frac{\partial}{\partial t} (c(x,t)) \quad \text{Continuity Equation}\]

Combine to get:

\[
\frac{\partial}{\partial t} (c(x,t)) = D \frac{\partial^2}{\partial x^2} (c(x,t)) \quad \text{Diffusion Equation}
\]

If you have a partition coefficient, $k$, then stick $k$ with $D$ in the above equations.

2-Compartment Model:

\[
P = \frac{kd}{d} \quad \text{Membrane Permeability}
\]

\[
\tau_{SS} = \frac{d^2}{\pi^2 D} \quad \text{Steady State Time Constant}
\]

\[
\tau_{EQ} = \frac{1}{AP \left(\frac{1}{V_1} + \frac{1}{V_2}\right)} \quad \text{Equilibrium Time Constant}
\]

If $\tau_{SS} \ll \tau_{EQ}$ (thin membrane) and at steady state then:

\[
\phi = P(c^1(t) - c^2(t)) \quad \text{Fick’s Law for membranes}
\]