

CHAPTER OVERVIEW

12: Diffusion in a Potential

In this section, we extend the concepts of diffusion and Brownian motion into a regime where the time-evolution is not entirely random, but includes a driving force. We will refer to this class of problems as diffusion in a potential, although it is also referred to as diffusion with drift, diffusion in a velocity or force field, or diffusion in the presence of an external force. We will see that these problems can be related to a biased random walk or to motion of a Brownian particle subject to an internal or external potential. Our discussion below will be confined to problems involving diffusion in one dimension.

The common theme is that we account for transport of particles through a surface in terms of two sources of flux, the diffusive flux and an additional driven contribution that arises from a potential, field, or external force experienced by the particle:

$$J = J_{diff} + J_U \quad (12.1)$$

Here we label the second flux component with U to signify potential. This may be a result of an external force acting on a diffusing system (for instance, electrophoresis and sedimentation), or the bias that results from interactions between diffusing particles. In mass transport through fluid flow the second term is known as the advective flux, $J_U \rightarrow J_{adv}$.

[12.1: Diffusion with Drift](#)

[12.2: Biased Random Walk](#)

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