

Reading Assignments for Week 14

- Wednesday, April 23: Section 16.1 up to beginning of 16.1.1 (pp. 623–625) and Section 16.2 up to beginning of 16.2.3 (pp. 639–647).
- Friday, April 25: Sections 16.2.3 and 16.2.4 (pp. 647–656).
- Monday, April 28: No new reading.

Homework #11 — due TUESDAY, April 29, 5pm

From lecture of Wednesday, April 23

1. **Problem S: Solution to the Smoluchowski Equation.** Show that Eq. (16.16) is the solution to the Smoluchowski equation, Eq. (16.6).
2. **Problem 16.1**

From lecture of Friday, April 25

3. **Problem T: Force Dependence of Motors.** Consider kinesin walking along a microtubule, taking steps of size 8 nm for each ATP consumed, and assume the concentration of ATP is such that $\Delta G_{\text{hydrolysis}} = -20k_B T$.
 - (a) Use the washboard model to estimate the stalling force F that would cause the motor to stop moving in the case where the forward step is force-dependent, but the backward step is not.
 - (b) Estimate the stalling force F that would cause the motor to stop moving in the opposite case where the backward step is force-dependent and the forward step is not.
 - (c) The unloaded ($F = 0$) kinesin is observed to move at speed of 30 nm/s. For both cases above, estimate the velocity of the motor in the case where the force is one quarter of the stalling force.

4. **Problem U: ATP Dependence of Motors**

Now consider the same kinesin motor as in Problem U, but with ATP added until its concentration is doubled.

- (a) Determine $\Delta G_{\text{hydrolysis}}$ for a single ATP consumed.
- (b) Determine the speed of the motor with no external force applied, assuming the washboard model when the forward step is dependent on the ATP concentration and the backward step is not.
- (c) Determine the speed of the motor with no external force applied in the opposite case, when the backward step is dependent on the ATP concentration and the forward step is not.