

Biology 3550
Physical Principles in Biology
Fall Semester 2016

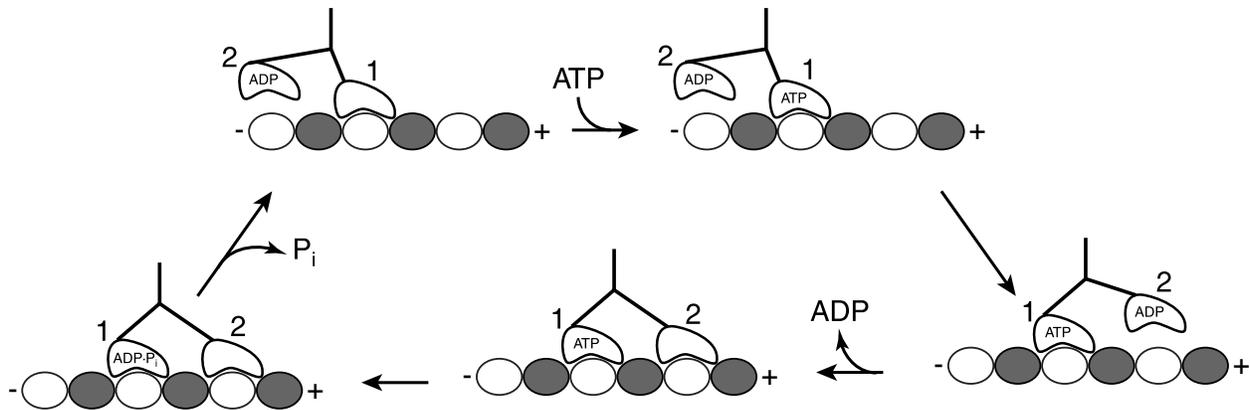
Quiz 5
5 December 2016

Please write your name on each page.

Be sure to show your work and include correct units in all of your answers!

25 points total.

In class, we briefly discussed kinesin, a molecular motor that moves along microtubules in eukaryotic cells. This motor shares several features in common with the two-headed myosins, but also differences. The drawing below shows a model for the catalytic cycle of this motor:



The microtubule is illustrated in a simplified form, with only one row of tubulin subunits shown. There are two types of tubulin subunits, which alternate, and the two kinesin heads are identified as “1” and “2”.

Though we did not discuss this cycle explicitly, you should be able to apply the general principles of molecular motors that we discussed in class to understand this mechanism.

- (8 pts) In the scheme above, there are four different states of the kinesin head, defined by the state of the nucleotide binding site. For each of these states, listed below, indicate how the state of the nucleotide binding site influences the other properties of the molecule.

- Empty

- ADP-bound

Name: _____

- ADP and inorganic phosphate (P_i) bound

 - ATP-bound
2. (4 pts) Like myosin, kinesin moves in a preferred direction along its track, indicated as $- \rightarrow +$ in the diagram. In the scheme proposed above, in which step is the directionality established? What feature of the kinesin molecule determines the directionality?
3. (4 pts) Suppose that a cell were depleted of ATP, but not ADP. In what state would you expect the kinesin to accumulate? Specify whether zero, one or both of the heads would be bound to the microtubule, and explain your reasoning.

