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Biology 3820
Physical Principles in Biology
Spring Semester 2011

Quiz 5
22 April 2011

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.

1. (8 pts) In class, we discussed four rather specialized forms of fluorescence microscopy, listed below. In the spaces provided, briefly describe the enhancement each of these techniques brings, relative to ordinary epifluorescence microscopy.

- Total internal reflectance fluorescence (TIRF) microscopy:

- Confocal microscopy:

- Stimulated emission depletion (STED) microscopy:

- Stochastic optical reconstruction microscopy (STORM):

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2. (8 pts) Two of the methods listed in the previous problem involve scanning the sample with the excitation light source and assembling an image point-by-point, while the other two methods can be used to capture a full image.

- Identify the two methods that involve scanning and explain why this is necessary.

- For each of the two methods that do not require scanning, identify an important limitation that is also associated with the technique.

STOP!

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3. (9 pts) During a single catalytic cycle, a myosin head can translocate an actin fiber by approximately 10 nm, coupled to the hydrolysis of one ATP molecule. For the following, assume that the temperature is 37°C and that the standard free energy change (ΔG°) for ATP hydrolysis is 35 kJoule/mol.
- (a) Suppose that the intracellular concentrations of ATP, ADP and inorganic phosphate (P_i) are all 5 mM. What is the theoretical maximum amount of work that could be obtained from the hydrolysis of one molecule of ATP?
- (b) Assuming that the force on the motor remains constant during the power stroke, what is the maximum amount of force that could be generated by a single myosin head under the conditions specified above?