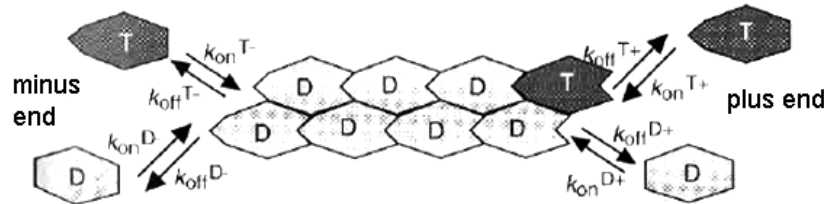


Quantitative Physiology I / Molecular and Cellular Systems; BMEN E4001x
HW5: Cell cytoskeleton and muscle physiology
Due Nov. 19, 2025.

1) Actin dynamics (10 points)

Consider the representation of actin thin filament assembly from ATP-bound and ADP-bound monomers:



	plus end			minus end		
	k_{on} ($\mu M^{-1}s^{-1}$)	k_{off} , s^{-1}	M_C , μM	k_{on}	k_{off}	M_C
ATP-actin	11.6 ± 1.2	1.4 ± 0.8	0.12 ± 0.07	1.3 ± 0.2	0.8 ± 0.3	0.6 ± 1.7
ADP-actin	3.8	7.2	1.9	0.16	0.27	1.7

This question focuses on the phenomenon of actin treadmilling, in which the structure undergoes net disassembly at the minus end net growth at the plus end. Consider the activity of ATP-bound actin only; assume that ADP-bound actin is not present.

- 1.1) Over what range of ATP-actin monomer concentration is treadmilling observed? Base this on the average values stated for the various rate constants. (5 pts)
- 1.2) At what ATP-actin monomer concentration is constant-length treadmilling observed? (5 pts)

2) Muscle physiology (10 points)

- 2.1) What is the molecular-level force associated with a single cross-bridge interaction? (5 pts)
- 2.2) What are two things that distinguish cardiac from skeletal muscle? (5 pts)

Note: The Boron & Boulpaep text is useful for these questions.

3) Continuous cell lines (10 points)

Continuous cell lines are a valuable tool in research. In using these models, it is important to recognize and respect their specific history. For a continuous cell line of your choice, describe:

- Why did you choose this type of cell?
- The type of cell (*e.g.*, neuron, osteoblast, or macrophage) that the model represents.
- The source of the cell line, including species and method of preparation.
- Ethical impacts associated with the generation of the cell line.
- Shortcomings of the cell line, such as species or relevance to disease.
- A discovery or insight that was made using these cells. Cite your source, such as primary research, webpage, or book chapter.

A paragraph of up to 15 sentences is appropriate for this question. The American Type Culture Collection (www.atcc.org) provides information on a wide range of cell lines. As appropriate, summarize a range of perspectives on the issues surrounding the chosen cell line.