

Consider two motor proteins according to the one-state-model (as discussed in the lecture) with the same energy consumption per step (e.g. one ATP molecule) but different step lengths. What can you say about the two motor proteins?

- ☐ The protein with the larger step length has a higher stall force.
- ☒ The protein with the smaller step length has a higher stall force.
- ☐ Their stall forces are similar, but their zero-force velocities are different.
- ☐ Both their stall force and their zero-force velocity are similar.

Diffusion theory is also applied in various other fields of research. For example, the effective diffusion constant of languages in the alpine regions of south Austria was recently determined as $D \approx 0.1 \text{ km}^2/\text{y}$ (Prochazka & Vogl, Proc. Natl. Acad. Sci. USA 114, 2017). How long would it then theoretically take on average for a language to diffuse a distance of 1 km.

- ☒ ca. 5 years
- ☐ ca. 50 years
- ☐ ca. 500 years
- ☐ ca. 5000 years

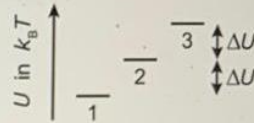
A semi-flexible polymer molecule is fixed at its two ends and the system is in thermal equilibrium at temperature T . When the temperature is increased...

- ☐ the force at the endpoints decreases.
- ☒ the force at the endpoints increases.
- ☐ the force at the endpoints stays constant.
- ☐ the molecule breaks.

The persistence length of a semi-flexible polymer does not depend on...

- ☐ the cross section diameter of the polymer.
- ☒ the total length of the polymer.
- ☐ the mechanical properties of the polymer material.
- ☐ the temperature.

Consider a system in thermal equilibrium that can occupy one of three equidistant states, denoted as 1, 2, and 3, with a difference in inner energy $\Delta U = 1 k_B T$ and with a probability p_1 , p_2 , and p_3 , respectively (see schematic). How large is p_1 ?



- ☐ ca. 0.123
- ☐ ca. 0.333
- ☒ ca. 0.665
- ☐ ca. 0.731

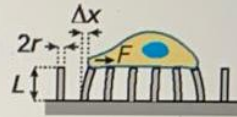
To observe magnetophoresis you need...

- ☐ a particle with a net charge.
- ☐ an inhomogeneous electric field.
- ☐ a homogeneous magnetic field.
- ☒ an inhomogeneous magnetic field.

While the densities of water and of honey are similar, the viscosity of honey is much higher than that of water and can reach up to $\eta_{\text{honey}} = 10 \text{ Pa}\cdot\text{s}$. If you move a spoon (length scale 1 cm) with a velocity of 1 cm/s through honey, what is the Reynolds number of the honey movement?

- ☐ ca. 10^{-4}
☒ ca. 10^{-2}
☐ ca. 1
 ☐ ca. 10^2

In an experiment a micropillar substrate is used to measure the forces generated by a cell (see schematic). The micropillars are made out of a polymer with Young's modulus $E = 2 \text{ MPa}$ and have a cylindrical shape with length $L = 8 \mu\text{m}$ and radius $r = 1 \mu\text{m}$ and their spring constant (at their upper end) is given by



$$k = \frac{3\pi E r^4}{4 L^3}.$$

If a micropillar is deflected by $\Delta x = 1 \mu\text{m}$, what is the lateral force acting F on it?

- ☐ ca. 0.1 nN
 ☐ ca. 1 nN
 ☒ ca. 10 nN
 ☐ ca. 100 nN

When you reduce the size of a system by a factor of 10, the surface to volume ratio increases by a factor of...

- ☐ $\sqrt{10} \approx 3.$
☒ 10.
 ☐ 100.
 ☐ 1000.