

Homework 2: Written Questions

Question 2:

Part (d)

No, I don't think this sequence is realistic. Proteins have micro environments of amino acids

with properties directed toward a task, the presence of one AA modifies the probability that one will follow

next in the sequence. For example: Cys forms disulphide bridges that covalently hold some proteins together.

While the probability of one Cys is low it increases significantly with the presence of another Cys residue.

Question 4:

Part (a)

The number of ways to permute n particles without restriction is $n!$. So we would have $8!$ arrangements of 8 distinct

particles. However, there are only two types of particles (B or W), so we need to divide by the number of permutations

in each group of 4 particles. Therefore, the number of permutations total is $8!/(4! \times 4!) = 70$.

Part (b)

Let B be the event "All four black particles are on one side of the membrane".

This arrangement is one of 70 possible,

so $P(B) = 1/70 = 1.43\%$.

The number of arrangements of 4 particles in 2 groups of size 3 and 1 is

$4!/(1! \cdot 3!) = 4$ arrangements, so the prob is

$4/70 = 5.7\%$.

The number of arrangements of 4 particles in two groups of equal size is $4!/(2!*2!) = 6$. So the probability is $6/70 = 8.5\%$.

The most likely arrangement is the one with 2 black and 2 white particles on one side of the membrane.

Part (c)

There is only one black particle on the right side of the membrane when the initial configuration on the left is

BBBW, so there is a $1/4$ chance of switching with the black one on the right.

However, the particle chosen from the left

is also random, and there is a $1/4$ chance of picking the W one, so there is a $1/4 * 1/4 = 1/16$ chance of switching to

BBBB.

There is a $3/4$ chance of picking a B from the left and a $3/4$ chance of picking a W from the right. So there is a

$(3/4)(3/4) = 9/16$ chance of switching to a conformation with two black and two white particles on the left. Intuitively

we can see that this option has more combinations and is more likely.

Question 6

Part (a)

$$F = -\frac{dU}{dx} = -kx$$

$$m\frac{d^2x}{dt^2} = -kx$$