TIGP727200   Physical Chemistry (II)

Homework   Due date: 24 April 2012

(1) Assume that the four bases **A**, **C**, **T**, and **G** occur with equal likelihood in a DNA
    sequence of nine monomers.
(a) What is the probability of finding the sequence **AAATCGAGT** through random
    chance?
(b) What is the probability of finding the sequence TTTTTTTTT through random
    chance?
(c) What is the probability of finding any sequence that has four **A**'s, two **T**'s, two
    G's, and one **C**, such as that in (a)?

(2) A biological membrane contains N ion-channel proteins. The fraction of time that
    any one protein is open to allow ions to flow through is q. Express the probability
    $P(m,N)$ that m of the channels will be open at any given time.

(3) In this lattice modal, each lattice site can hold either zero or one particle. Now
    there are V lattice sites. How many arrangements are there of 15 indistinguishable
    particles distributed on: (a) $V = 20$ sites? (b) $V = 16$ sites? (c) $V = 15$ sites?

(4) Second law of thermodynamic and Darwin's theory of evolution
    Darwin's theory of evolution suggests that all living organism are descended
    from a common ancestor. For instance, a bacteria cell and a human being have a
    common ancestor. Some suggest the theory violates the second law of
    thermodynamics. Do you know why Darwin's theory violates the second law of
    thermodynamics? Explain this view with respect to entropy. (Please elaborate
    your answer within 800 words and also cite your reference.)