

CHEM 519, Spring 2006

Homework Assignment #1

Total 70 points, due February 13, 2006

1. (5 pts) Stryer, Ch. 3, #15

2. (10 pts) An example of a  $3_{10}$ -helix is the pdb entry 1LB0.

- Conduct a literature search and report the following features of the  $3_{10}$ -helix: range of  $\phi$ ,  $\psi$  angles; H-bonding pattern; and residue per turn. Include your citation in the answer.
- Visualize the 1LB0 structure using the WebMol tool available from the pdb website (under "Display Molecule"). Generate a graph showing all atoms of the peptide, and indicate on your graph an example of the  $i$  to  $i+3$  backbone hydrogen bonding.

3. (10 pts) The *t*BOC group can be used as protection groups for both amines and esters, and it has been reported that one can selectively deprotect amines *vs.* esters (Gibson et. al., J. Org. Chem., 1994, 59, 3216-8). Explain in detail the mechanistic basis for such selective de-protection.

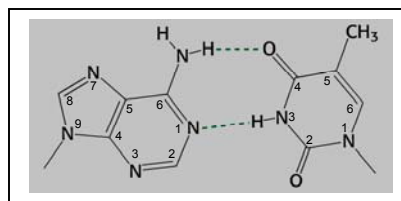
4. (10 pts) A peptide has the sequence HYGRPC. Based on data from Stryer, Ch. 3, Tables 3.1 and 3.4, construct an excel sheet to find its net charge at pH 7, 8, and 9. Then estimate the pI for this peptide.

5. (5 pts) Stryer, Ch. 4, #16; Describe in detail how you deduce the sequence.

6. (5 pts) Draw the chemical structures of: (1) Guanine; and (2) Cytidine.

7: (5 pts) For the DNA base pair shown:

- Is there any hydrogen bond donor in the major groove? If yes, name one.
- Is there any hydrogen bond donor in the minor groove? If yes, name one.



(c) Name one amino acid that can recognize this base pair through the minor groove via hydrogen bonding.

**8. (10 pts)** Explain why for the following two duplexes,  $T_m$  (duplex 1)  $>$   $T_m$  (duplex 2)?

duplex 1: 5' AAC, GGG, TTT, TTTG, CCC, AAA, A  
 duplex 2: 5' AAC, TGT, GTG, TTTG, ACA, CAC, A

**9. (10 pts)** In the diagram below, dashed lines represent target DNA sequences for PCR amplification, and the flanking sequences are shown.

1                      10                      20                      910                      920                      930  
 5' GCA, ATG, GTA, CGG, TAC, TTC, CAT, TGTC-----TAT, GTT, GGG, GAT, TAA, ACC, CTG, ATT, GAG 3'  
 3' CGT, TAC, CAT, GCC, ATG, AAG, GTA, ACAG-----ATA, CAA, CCC, CTA, CTT, TGG, GAC, TAA, CTC 5'

- (a) Write the sequences of the forward and backward primers for PCR, clearly indicate the 5' and 3' termini of each primer.
- (b) If the efficiency of amplification  $Y = 0.9$ , and the starting copy number is 1, how many cycles are required to obtain  $1 \times 10^9$  copies?