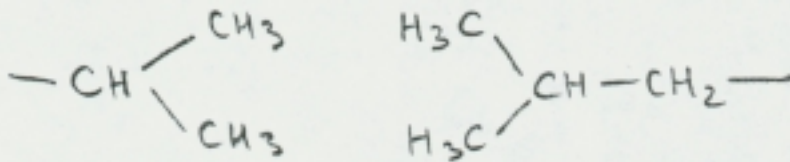


**Problem 4.** (24 pts total, 4 pts each)

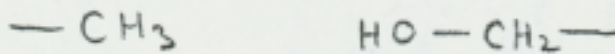
In a protein, the following pairs of amino acids happen to be close in space and, therefore, could potentially interact with each other. Draw the complete structure of these amino acids (**side chains only**). Indicate what type of interaction is possible between these side chains (if there is no interaction, clearly indicate that). Indicate clearly the charged groups of these amino acids at pH=7.0. In the case of hydrogen bonding, draw a dotted line to indicate the hydrogen bond and clearly label the donor and acceptor in each hydrogen bond.

(1) val - leu



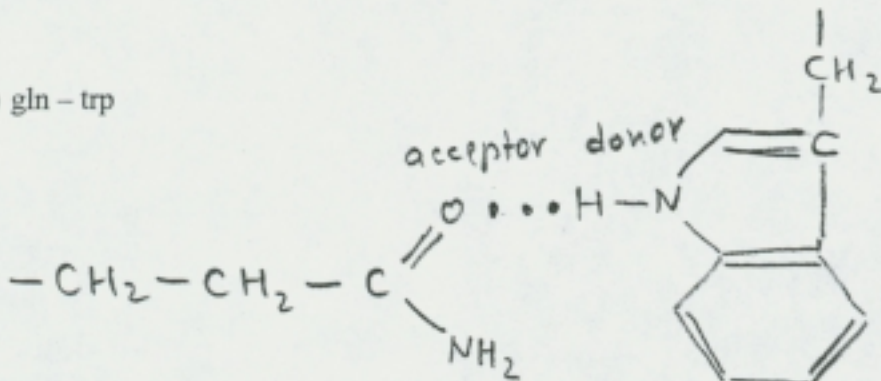
hydrophobic interaction

(2) ala - ser



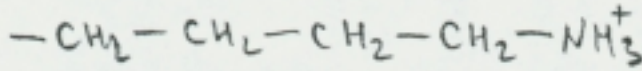
no interaction

(3) gln - trp

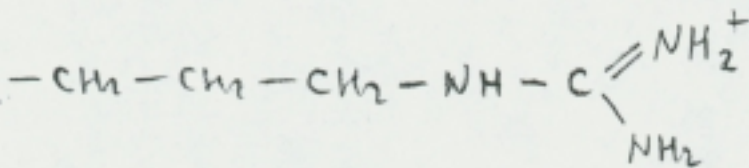


a hydrogen bond

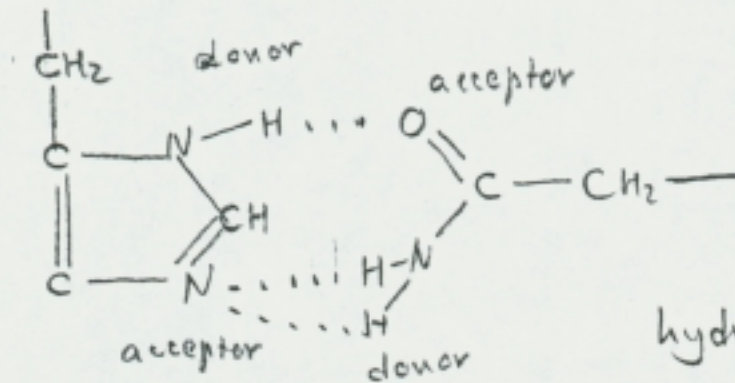
(4) lys - arg



both are positively charged  $\rightarrow$  electrostatic repulsion



(5) his - asn



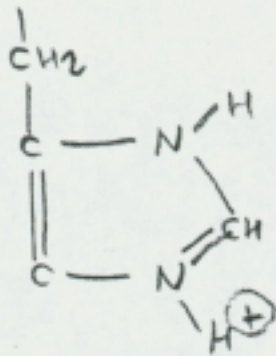
at this pH His could be both donor and acceptor of H-bonds

hydrogen bonds

Which of these interactions will be affected and how if the pH is lowered to pH=5.0?

His - Asn

At this pH His side chain would be protonated:



His can now serve only as a donor of H-bonds