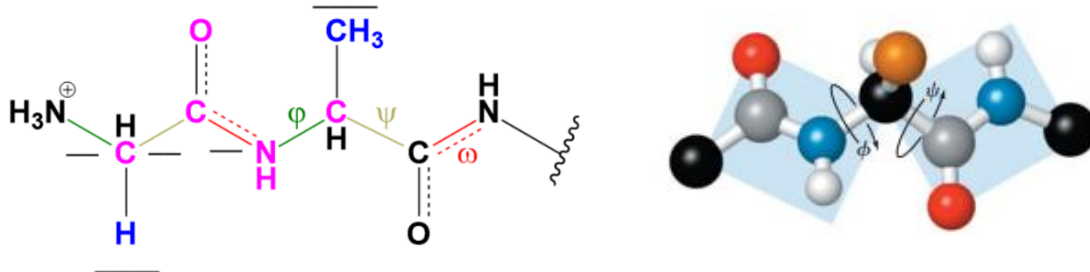


CONCEPT: RAMACHANDRAN PLOT

● Peptide bond rotation is limited, but bond-_____ around the C_α bonds are still possible.

- ☐ _____ (ϕ): rotation angles around the C_α -N bond.
- ☐ _____ (ψ): rotation angles around the C_α -C bond.
- ☐ _____ (ω): rotation angle of the peptide bond.

EXAMPLE: Phi, Psi & Omega bond angles.



PRACTICE: Which of the following pairs of peptide-backbone bonds show free rotation around both bonds?

- a) C_α -C and N- C_α
- b) C=O and N- C_α
- c) N-C and C_α -C
- d) N- C_α and N-C

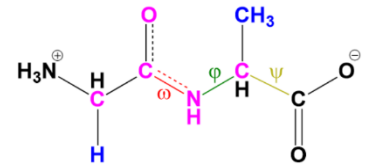
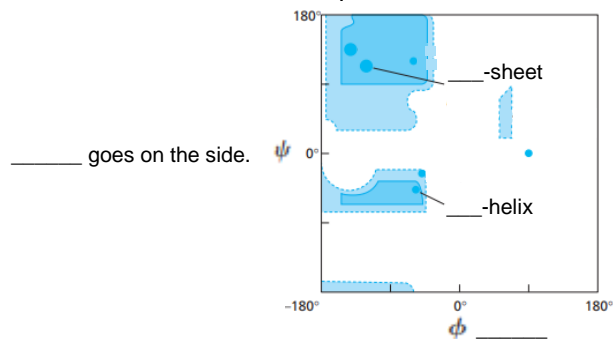
Ramachandran Plot

● Since *peptide bond rotation* (ω) is hindered by double-bond nature, ϕ and ψ determine the _____ of a polypeptide.

- ☐ ϕ and ψ are somewhat restricted by _____ hindrance between R-groups & the backbone carbonyl oxygens.
- ☐ Rotation angles range from -180° to 0° (_____ -clockwise angles) & 0° to $+180^\circ$ (clockwise angles).

● *Ramachandran plots*: show the _____ & non-permissible ϕ and ψ angles for an amino acid residue or protein.

EXAMPLE: Fill-in the blanks on the Ramachandran plot.



PRACTICE: A Ramachandran plot shows:

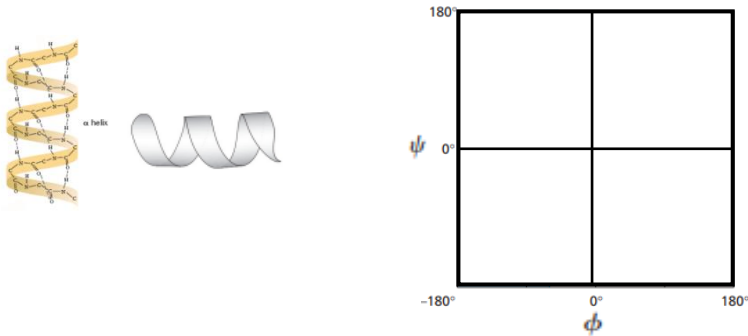
- a) The likelihood that proline bond angles allow it to form hydrogen bonds.
- b) The stability of the pK_a of amino acids in a hydrophobic environment.
- c) The values of the torsional angles and allows prediction of the protein/amino-acid conformation.
- d) The probability for a protein to be soluble or insoluble in polar solutions.

CONCEPT: RAMACHANDRAN PLOT

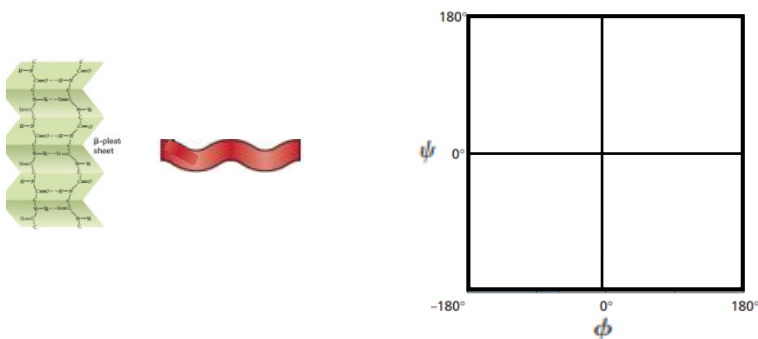
PRACTICE: Why are some regions of a Ramachandran plot shaded while others are unshaded? Circle all true answers.

- a) Shaded regions correspond to the most common permissible conformations and bond angles.
- b) Unshaded regions correspond to the ΔG values for each combination of phi & psi bond angles.
- c) Unshaded regions correspond to restricted bond angles that are non-permissible & less common.
- d) Shaded regions can be analyzed to reveal the full primary structure of a peptide.

PRACTICE: The predominate structure in α -keratin, a mammalian protein that makes up large portions of hair & nails, is the α -helix. Mark the approximate locations on a Ramachandran plot you might expect to find ϕ and ψ angles for α -keratin amino acid residues.



PRACTICE: The principal component of silk is the protein fibroin, which is a classic example of β -sheet structure. Mark the approximate locations on a Ramachandran plot you might expect to find ϕ and ψ angles for silk amino acid residues.



PRACTICE: Which of the following statements is true for the portion of the peptide shown in the figure below?

- a) Arrow A is pointing to the phi bond, B is pointing to the psi bond.
- b) Arrow B is pointing to the phi bond, C is pointing to the psi bond.
- c) Arrow C is pointing to the phi bond, A is pointing to the psi bond.
- d) Arrow C is pointing to the phi bond, B is pointing to the psi bond.

