

1. Which amino acid is able to form a disulfide bond?

cysteine

2. Where are disulfide bonds found

Oxidative conditions

Extracellular domain of some proteins

Can provide extra stability in harsh conditions

3. What types of bonds are present in proteins?

Hydrogen bonds

Van der Waals

Disulfide

ionic

4. How do hydrogen bonds form and provide attraction?

Between polar groups

Slight negative charge ( $\delta^-$ ) on electronegative atoms (N, O)

Slight difference in charges ( $\delta^+$ ,  $\delta^-$ ) allows a weak interaction to form between amino acid side chains, main chain C=O and N-H, and  $H_2O$

5. What makes for the strongest hydrogen bond?

Linear

Donor atom pointing along the acceptor's lone pair orbital (linear)

6. Energy of association =

$$E = \frac{kq_1q_2}{Dr}$$

$$k = 9 \times 10^9 \text{ JmC}^{-2}$$

$q_1, q_2 = 2$  electric charges

$r$  = distance of separation

$D$  = dielectric constant

7. Name the 3 types of van der Waals interactions:

Dipole–dipole

Dipole–induced dipole

London dispersion forces (induced dipole–induced dipole)

8. What is the hydrophobic effect?

Influence causing non-polar substances to minimise contact with water

Amphipathic molecules form micelles in aqueous solution

Water molecules form cages around hydrophobic molecules (or hydrophobic parts of molecules)

9. What happens to entropy if a hydrophobic side chain is buried?

Increases entropy of solvent, as the water molecules involved in caging are released

10. Which of: ionic, dipole-dipole; interactions stabilise the protein structure the most?

Dipole–dipole, due to high numbers

11. What is the strongest non-covalent interaction in a protein?

Hydrogen bonds

12. Folding of a protein is driven by an:

Increase in entropy, by burying hydrophobic residues

13. Length of a H bond =

2 *angstroms* (2.4–3.6 Å)

14. How does a permanent dipole form an interaction

Induced dipole moment on neighbouring group forms an interaction

Weaker than dipole-dipole

15. How do London dispersion forces form interactions?

Rapid fluctuations in electron density cause spontaneous dipoles to form

This forms a dipole on a neighbouring group, forming an attractive force

16. For a protein to fold spontaneously, change in Gibbs Free energy must be:  
negative

17. For protein folding to be spontaneous, change in enthalpy must be:  
Slightly negative

18. For protein folding to be spontaneous, change in entropy must be:  
Positive

Increase in entropy due to the release of water molecules around the hydrophobic side chains

19. On folding, hydrophobic residues tend to be...

Buried within the non-polar core of the protein

20. Draw all 20 side chains

 amino acid structures.pdf