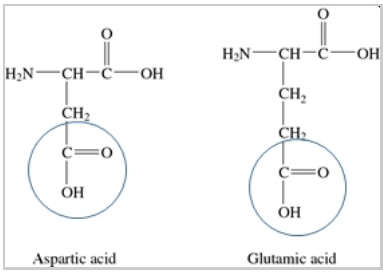
Name: _____ Class: _____ Date: _____

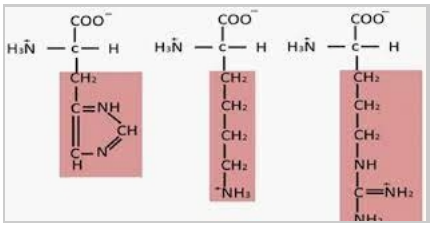
Read each question carefully. Some questions have multiple parts. Answer all questions with complete sentences.

1. Draw an example of each of the following molecules. Answer any additional questions given.

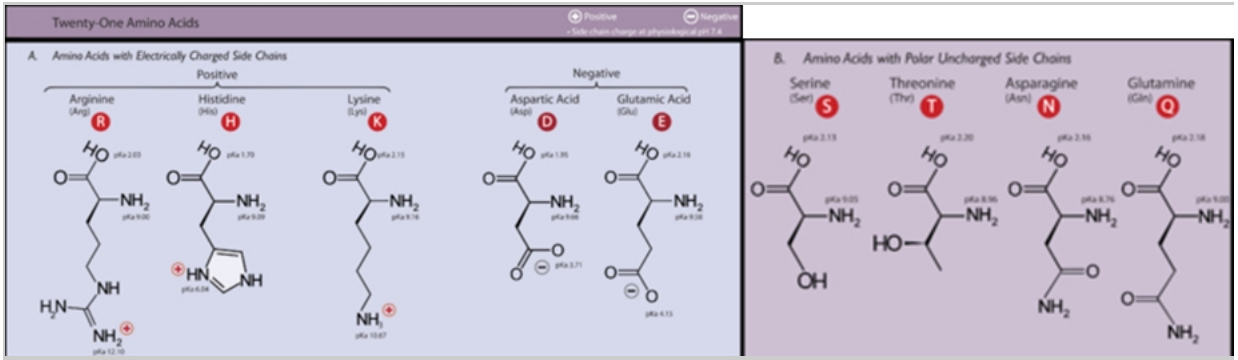
   (a) An acidic amino acid (Circle the acidic part)



   (b) A basic amino acid (Circle the basic part)

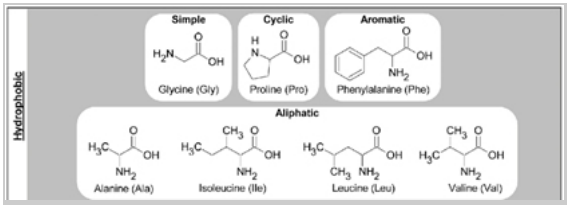


   (c) A hydrophilic amino acid (Explain.)



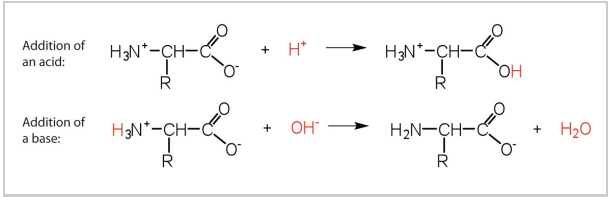
R group must be COOH, OH or NH2
Must be able to HB with water

   (d) A hydrophobic amino acid (Explain.)



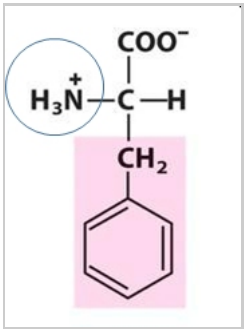
R group must be aliphatic or aromatic
Should have LDF only

   (e) Zwitterion of Serine **AND** how it reacts with an acid (H^+)

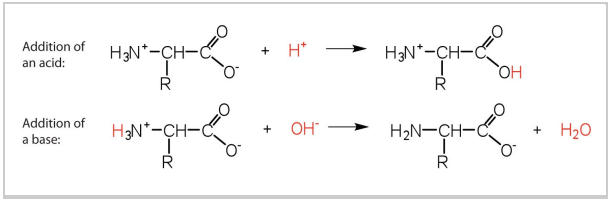


R group should be serine (CH_2OH) and top reaction only
COO^- and NH_3^+ R group is not changed

(f) L-Phe (circle the L part)

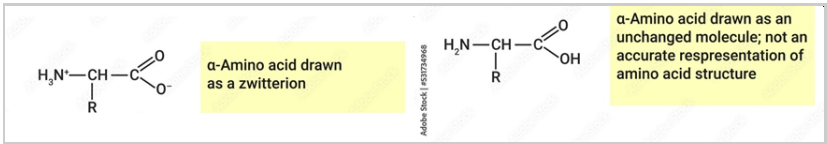


(g) Zwitterion of Asp and how it would react with a base ([OH−]



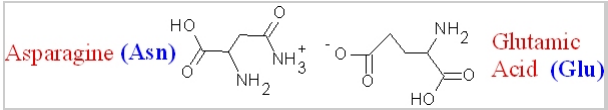
R group should be Asp (CH_2COOH) and bottom reaction only
NH_2 and COO^- R group is not changed

(h) A Zwitterion. (Define Zwitterion, why do they occur)

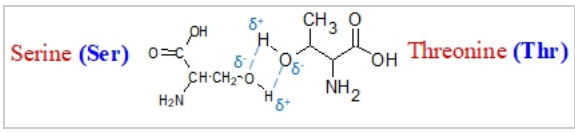


Zwitterions occur because amino acids are amphoteric and can act as acids and bases. It is a more accurate representation of the molecule in physiological (biological) conditions.

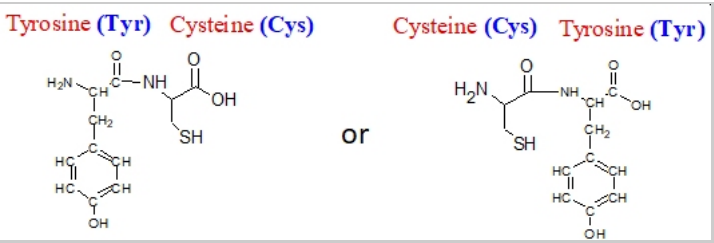
(i) A salt bridge between Glu and Asn.



(j) An example of Hydrogen bonding between Ser and Thr

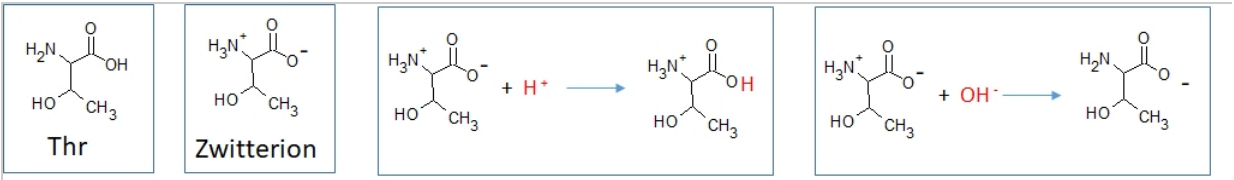


(k) The dipeptide made from Tyr and Cys (What type reaction occurs? What type of bond is created according to biologists? according to chemists?)

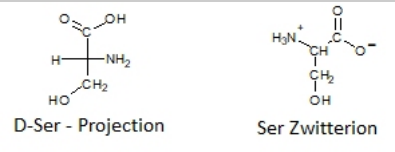


Two different answers possible (order matters) Tyr-Cys or Cys-Tyr
Dehydration Reaction
Biologists - Peptide or Dipeptide
Chemists - Amide

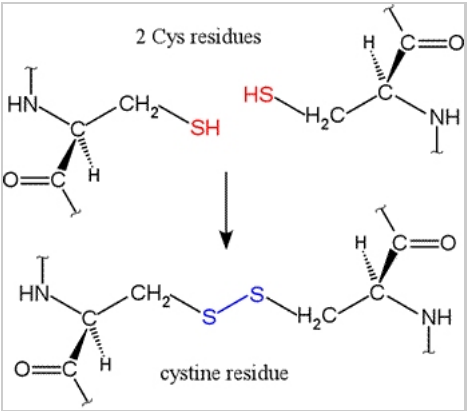
(l) Draw the Zwitterion of Threonine. Show how it would react to neutralize (a) H^+ and (b) OH^-.



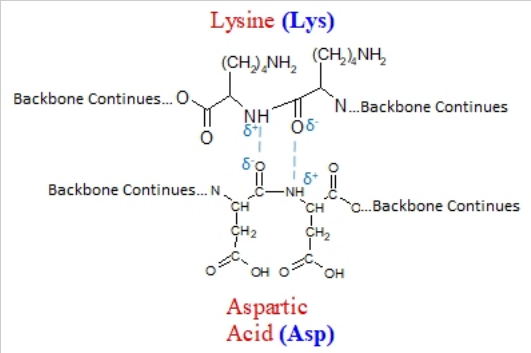
(m) Draw the Fischer projection of D-Ser. Draw the zwitterion of Ser.



(n) A disulfide bond between two amino acids.

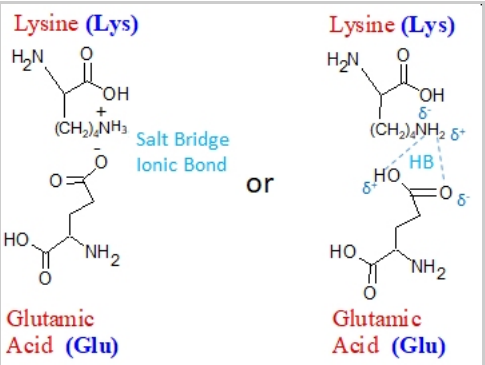


2. Define Secondary Structure. What IMF is responsible for secondary structure? What are the two most common examples of secondary structure? Draw a picture between ASP and LYS.



Interactions between amide groups in the polypeptide chain.
Hydrogen Bonds
α-helix - between amide groups 4 AA apart
β-pleated sheets - between a series of amide groups far apart.

3. Define Tertiary Structure. Draw an example of how GLU and LYS would interact. Which IMF is responsible for the interaction?



Interactions between R-groups in the polypeptide chain.
5 Types - HB, Ionic Bond (Salt Bridge), Disulfide Bonds, Hydrophobic and Hydrophilic
Between GLU and LYS would be either hydrogen bonds or a salt bridge (either answer is correct).

4. What is meant by the term complete protein?

The body can't synthesize some AA therefore they muse be obtained in the diet. A complete protein is one that contains all of the AA that the body can't synthesize.

5. What is meant by the term essential when discussing lipids and amino acids?

Required for proper metabolic function. The body can't synthesize some AA/Lipds therefore they muse be obtained in the diet.

6. Give 1 biologically important use for each of the following classes of compounds

   (a) Nucleic Acids DNA/RNA

   (b) Amino Acids Enzymes + 6 other possible uses

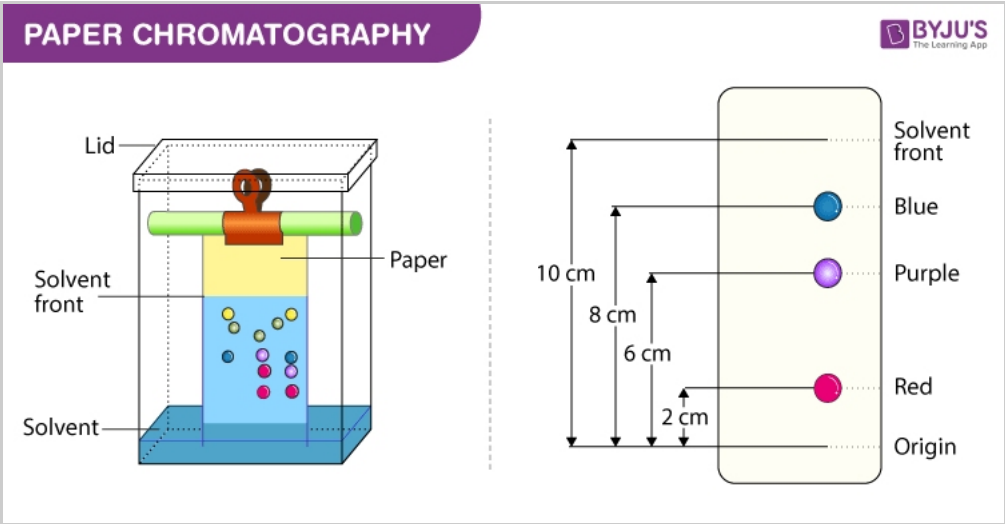
   (c) Proteins Structural support, storage, transportation, defense, motion/movement, regulation, catalysts

   (d) Enzymes Catalysts - speed up reactions

7. Define Denaturation. List 4 ways to denature proteins

DFN - loss of 3D conformation of proteins, specifically the 2, 3, 4 structure but not the 1 structure.
1. Agitation
2. pH
3. Temperature
4. SA/SB
5. Alcohol
6. Heavy Metals
7. Enzymes
8. UV light

8. A student performs a chromatography experiment to try and separate the amino acids Leu and Asp. Sketch a picture of the experimental setup. Which AA would move the furthest up to chromatography paper if the solvent is WATER? Explain.



Asp is more polar (water soluble(therefore would move up the chromatography paper faster/further.

9. A student performs a chromatography experiment to try and separate the amino acids GLU and PHE. Sketch a picture of the experimental setup. Which AA would move the furthest up to chromatography paper if the solvent is HEXANE? Explain.

see previous answer
3 pts - GLU = glutamic acid, the COOH functional group will make is soluable in water but NOT soluable in Hexane, therefore it will not move up the chromatography paper. PHE has a phenyl group which is non-polar and will dissolve readily in hexane and move further up the paper.

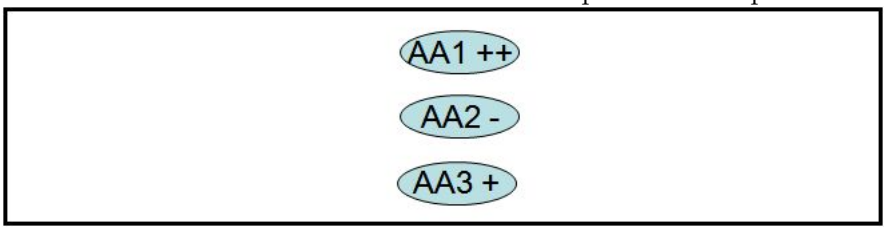
10. A student performs a chromatography experiment to try and separate the amino acids SER and VAL. Sketch a picture of the experimental setup. Which AA would move the furthest up to chromatography paper if the solvent is HEXANE? Explain.

see previous answer
VAl is nonpolar (alkane FG) while SER is polar (alcohol FG) therefore VAL will dissolve more readily in hexane and move further up the paper.

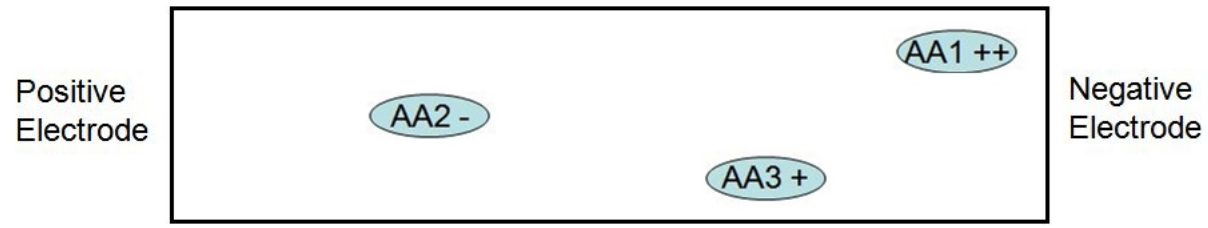
11. Electrophoresis can be used to separate amino acids and proteins by what two properties of the molecules?

Charge and Size.

12. A student performs an electrophoresis experiment to try and separate the amino acids shown below. Show the position of the amino acids at the end of the experiment. Explain.



Distribution of Amino Acids (AA) after application of an electric field):



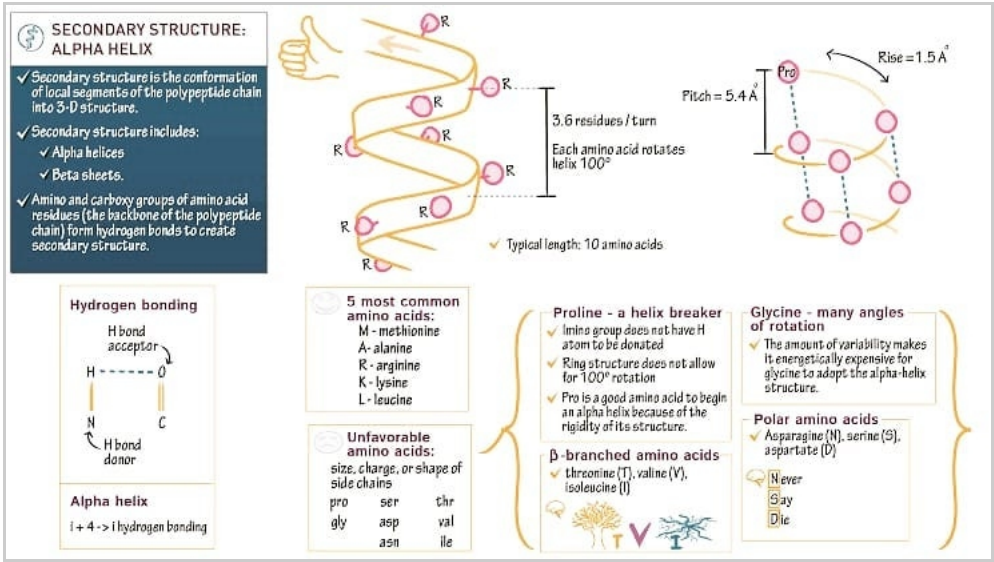
13. Define Primary structure (in its usage for describing proteins).

Number, Type, and Order of the amino acids in a protein.

14. Define the term Secondary Structure, **AND** list the 3 types discussed in class.

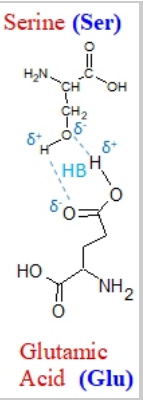
DFN - Hydrogen bonds between Amide groups on the backbone (1 pt) of the protein chain. Depending on the distance apart you get:
(1) *alpha*-helix
(2) *beta*-pleated sheet
(3) triple-helix

15. Draw a picture of an α-helix. What is responsible for the formation of this structure? Is this an example of primary, secondary, tertiary, or quaternary structure?



Hydrogen Bonds
Secondary

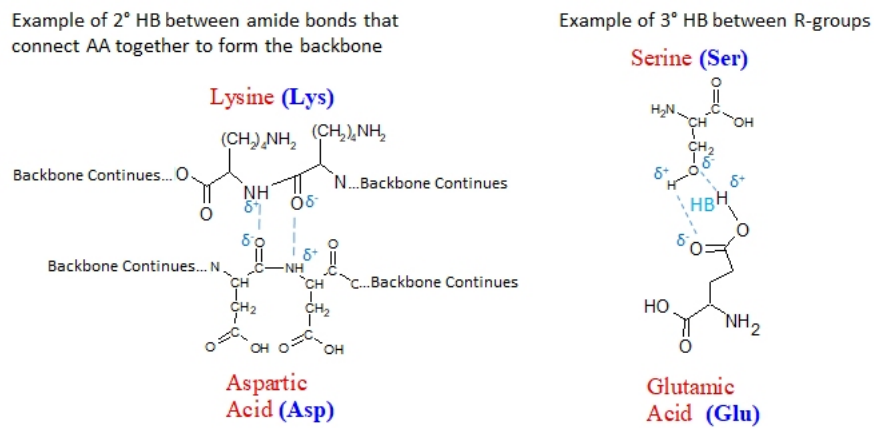
16. Define the term Tertiary Structure, **AND** list the 5 types discussed in class. Draw an example of the interaction that would occur between GLU and SER. Which of the 5 interactions does this illustrate?



DFN - Interaction between R-Groups
(1) Hydrogen Bonds
(2) Salt Bridge
(3) Disulfide Bonds
(4) Hydrophylic
(5) Hydrophobic
Picture should resemble that shown in book.
Hydrogen Bond

17. What is the difference between the hydrogen bonding responsible for secondary structure and that responsible for tertiary structure? Draw an example of each illustrating the difference.

Hydrogen bonds in secondary structure are between the amide/peptide bonds in the backbone and lead to the formation of α-helix, $\beta-$pleated sheet.
Hydrogen bonds in tertiary structure are between the R-groups.

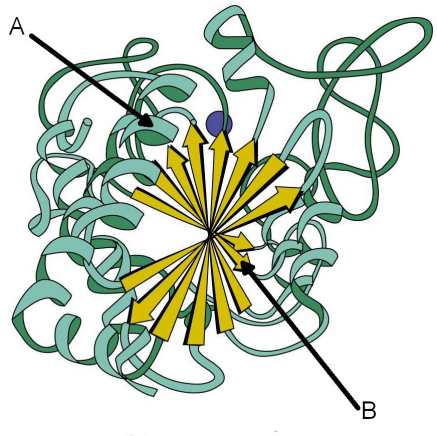


18. Proteins have many functions in the body. List the 7 examples given in the book.

Hein 29.8

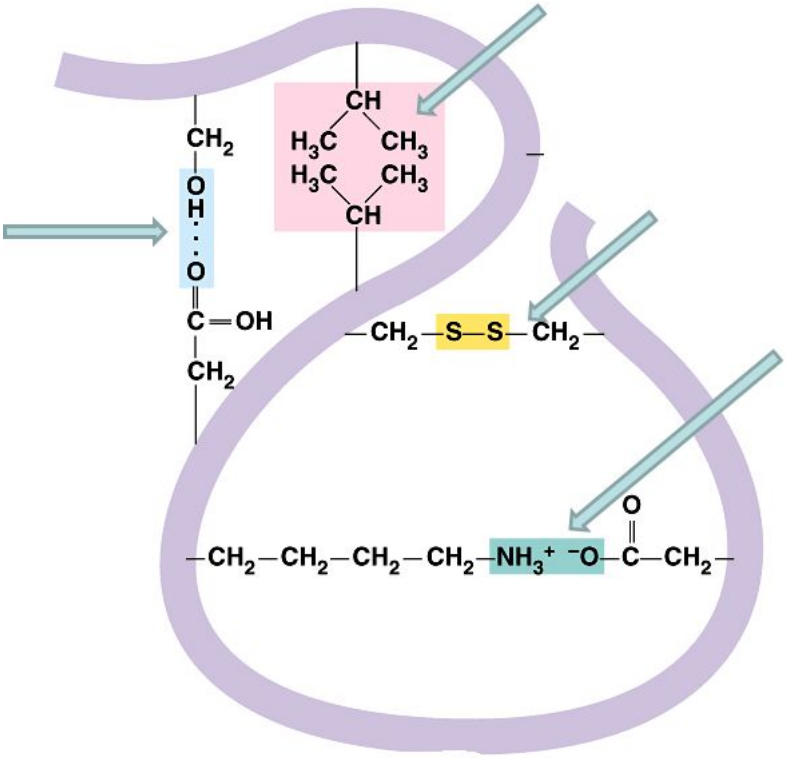
1. Structural support
2. Storage
3. Transport
4. Defense
5. Motion/Movement
6. Regulation
7. Catalysis

19. What feature of a protein is illustrated by A? What feature of a protein is illustrated by B? Both of these are examples of primary, secondary, tertiary, or quaternary structure?



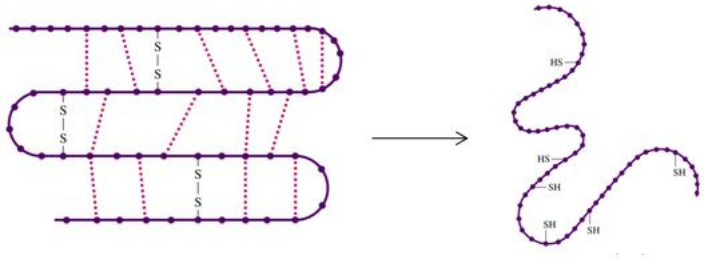
(a) α-helix (secondary structure)
(b) β-pleated sheet (secondary structure)

20. Label each of the interactions. These are examples of what type of structure in proteins: primary, secondary, tertiary, or quaternary structure? Which interaction is missing?



Light Blue - HB
Pink - Hydrophobic
Yellow - Disulfide bond
Dark Blue - Ionic Bond/Salt Bridge
All are examples of tertiary structure
Missing - Hydrophilic

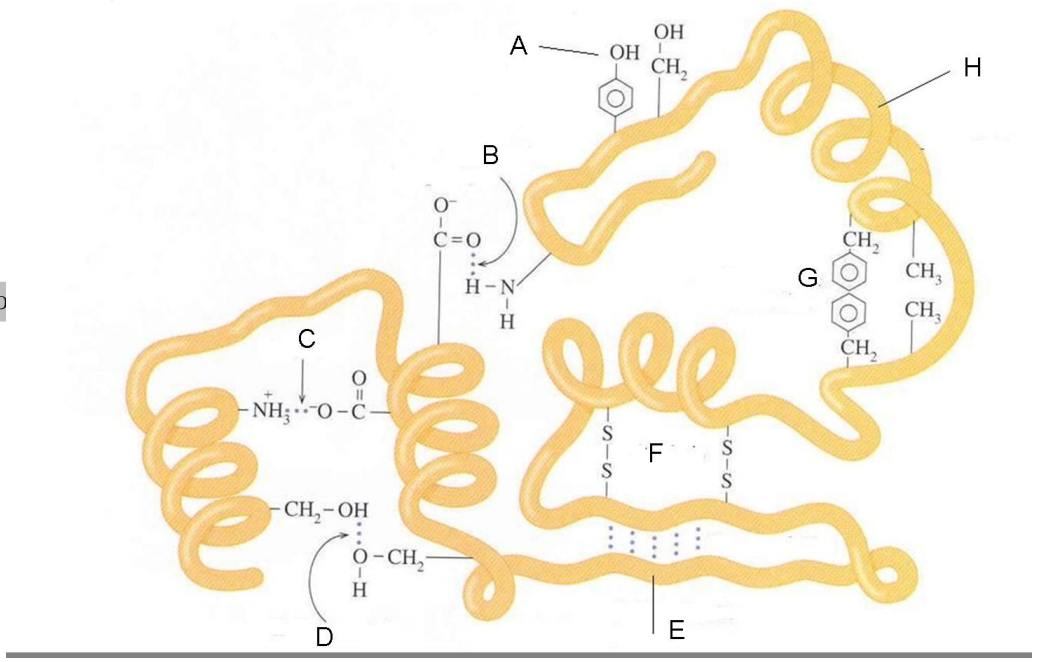
21. What process is being illustrated here. List 3 ways this might have occurred.



Hein 29.10 - protein loses its 3D conformation due to the alteration or disruption of the secondary, tertiary or quaternary structure, but **NOT** its primary structure. Figure 29.12 is a good illustration of this.

Examples include: (1) Heat, (2) Changes in pH, (3) Organic Molecules (4) Heavy Metals, (5) Agitation, (6) UV Light, (7) Enzymes and (8) Salts. Other examples are possible as are more specific examples instead of the categories listed.

22. Label each of the interactions or parts below. Choices are: α-helix, β-pleated sheet, Disulfide bonds, H-bonds, Hydrophilic, Hydrophobic, Salt Bridges, Triple helix. (Hint: There is one interaction used twice, and one not pictured at all.)



(a) Hydrophilic

(b) Hydrogen Bond

(c) Salt Bridge/Ionic Bo

(d) Hydrogen Bond

(e) β-pleated sheet

(f) Disulfide bonds

(g) Hydrophobic

(h) α-helix

23. Complete the table below for each test. Include what functional group/feature of the molecule it test positive (+) and negative (-) for and the visual change which indicates each.

Test Name	**Positive for:**	**Visual Change**	**Negative for:**	**Visual Change**
Biuret Test	2 amide bonds, polypeptide (3+ AA)	light blue to purple/violet/darkblue	Single AA, Dipeptide (non-protein molecules)	no color change (light blue)
Tyrosine	AA Tyrosine (Tyr) by itself or in a protein	clear to yellow/orange/red	Anything w/o Tyr	clear
Ninhydrin	Proteins (free/end amine group of AA)	clear to blue/purple or yellow	Carbohydrate and Lipds	no color change (clear)
Xanthoproteic	Phenyl group in Tyr, Try	clear to orange/red	Anything w/o Tyr, Try. Carbohydrates, Lipids	clear (no color change)
Sulfur Test	AA Cys by itself or in protein	black ppt	Anything w/o Cys, Carbohydrates, Lipids	clear (no color change or ppt)