

## 13.4: Amino Acids and Proteins (Exercises)

These are homework exercises to accompany [Chapter 13](#) of the University of Kentucky's LibreText for [CHE 103 - Chemistry for Allied Health](#).

### Questions

#### 13.1: Amino Acids

[\(click here for solutions\)](#)

##### Q13.1.1

Read the material at <http://hyperphysics.phy-astr.gsu.edu/hbase/organic/essam.html> and answer the following questions:

- What are essential amino acids?
- What are nonessential amino acids?
- What happens if you are deficient in an amino acid?

##### Q13.1.2

Draw the functional groups present in all amino acids.

##### Q13.1.3

Complete the following for threonine, lysine, and tyrosine.

- Draw the amino acid.
- Circle the side chain.
- Identify whether it is polar, nonpolar, acidic, or basic.
- At what pH will it exist as a zwitterion?
- What is the range of pH values when it will be positively charged?
- What is the range of pH values when it will be negatively charged?

#### 13.2: Peptides

[\(click here for solutions\)](#)

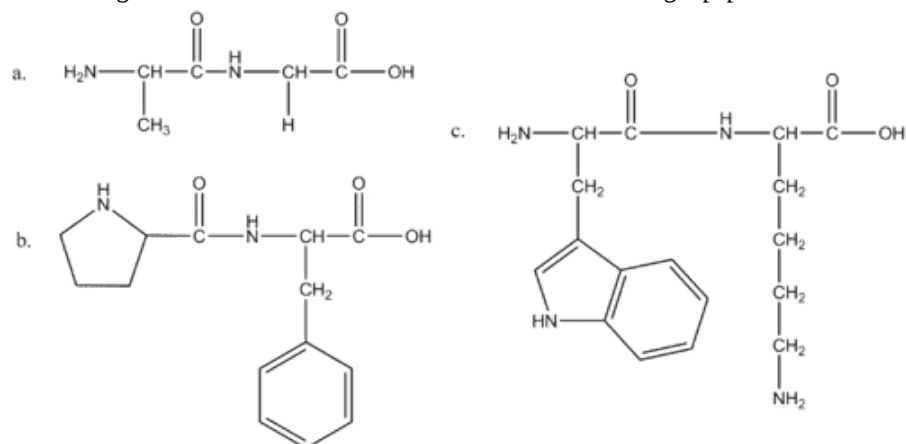
##### Q13.2.1

Draw the two dipeptides formed from each pair of amino acids.

- tyrosine and lysine
- threonine and glutamine
- alanine and histidine

##### Q13.2.2

Draw and give the full names of the amino acids in the following dipeptides.



### Q13.2.3

List of all of the possible polypeptides that can be formed from threonine, alanine, and phenylalanine (use three character abbreviations for each amino acid).

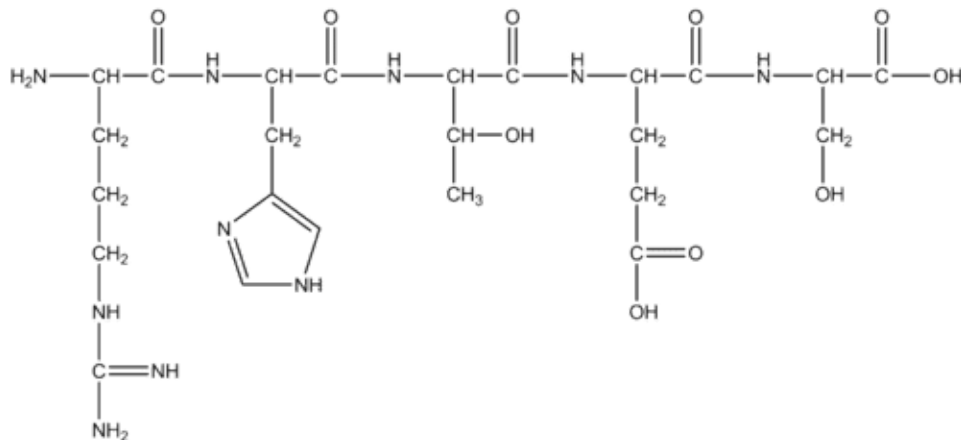
### Q13.2.4

Draw the following polypeptides.

- Ser-Tyr-Gln
- Lys-Met-Gly

### Q13.2.5

Identify each of the amino acids in the polypeptide and then name it using the three character abbreviations.



## 13.3: Protein Structure

[\(click here for solutions\)](#)

### Q13.3.1

Describe the four levels of protein structure.

### Q13.3.2

What levels of structure involve hydrogen bonding?

### Q13.3.3

What types of structure is the result of interactions between amino acids that are far apart in the primary structure?

### Q13.3.4

What types of interactions hold the secondary structure together?

### Q13.3.5

What types of interactions hold the tertiary structure together?

### Q13.3.6

What levels of structure are affected by denaturation?

### Q13.3.7

A protein has one subunit. Would it have a quaternary structure?

## Answers

### 13.1: Amino Acids

#### Q13.1.1

- Essential amino acids are those you get from your diet.
- Nonessential amino acids are produced in the body.
- Illness and/or degradation of body's proteins.

### Q13.1.2



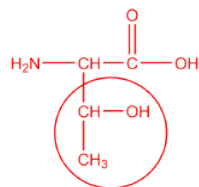
amine and carboxylic acid

### Q13.1.3

Complete the following for threonine, lysine, and tyrosine.

#### threonine

a.



b.

c. polar

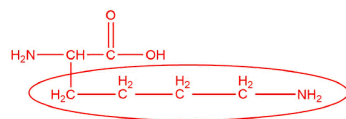
d. 5.60

e. < 5.60

f. > 5.60

#### lysine

a.



b.

c. basic

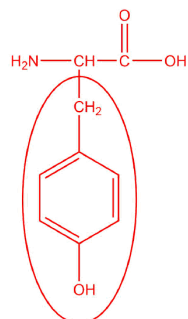
d. 9.47

e. < 9.47

f. > 9.47

#### tyrosine

a.



b.

c. polar

d. 5.63

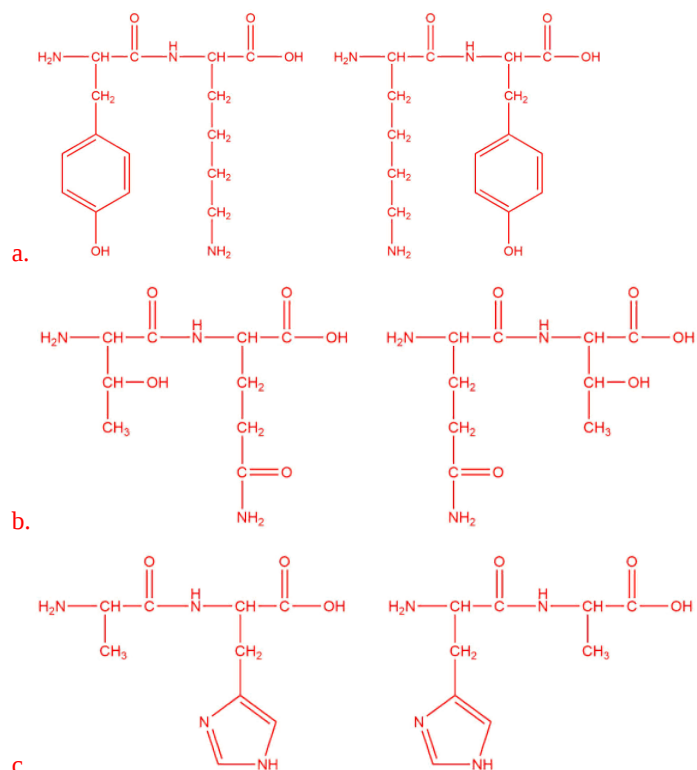
e. < 5.63

f. > 5.63

## 13.2: Peptides

### Q13.2.1

Draw the two dipeptides formed from each pair of amino acids.



### Q13.2.2

a.	 alanine	 glycine
b.	 proline	 phenylalanine
c.	 tryptophan	 lysine

### Q13.2.3

Thr-Ala-Phe

Thr-Phe-Ala

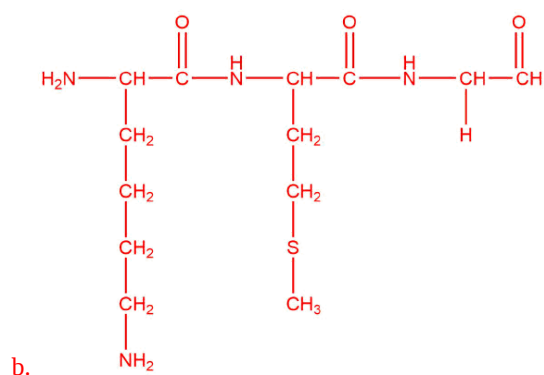
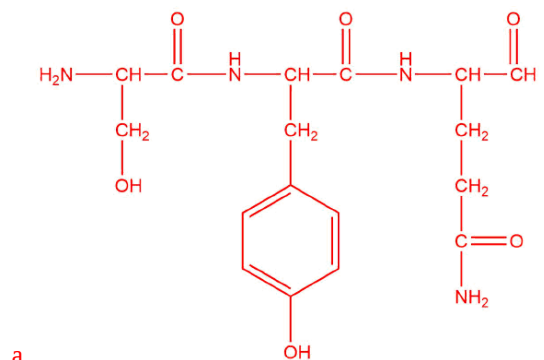
Ala-Thr-Phe

Ala-Phe-Thr

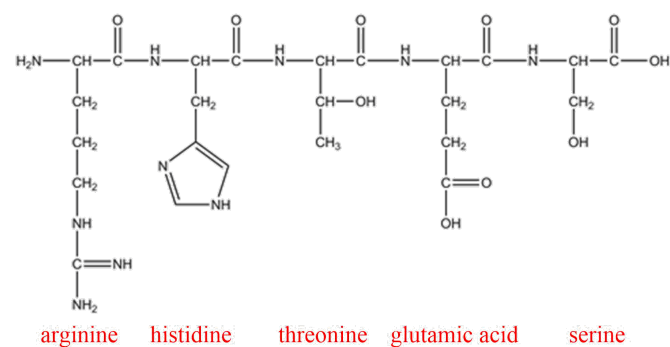
Phe-Ala-Thr

Phe-Thr-Ala

### Q13.2.4



### Q13.2.5



Arg-His-Thr-Glu-Ser

## 13.3: Protein Structure

### Q13.3.1

Primary - sequence of amino acids

Secondary - alpha helix and Beta-pleated sheets held together by hydrogen bonds

Tertiary - third level of structure of protein often forming globular or fibrous structure, held together by variety of attractive forces

Quaternary - complex of multiple proteins held together to function as one, held together by variety of attractive forces (same as tertiary)

**Q13.3.2**

secondary, tertiary, and quaternary structures

**Q13.3.3**

tertiary structures

**Q13.3.4**

hydrogen bonds

**Q13.3.5**

London dispersion forces, hydrogen bonds, dipole-dipole forces, ion-dipole interactions, salt bridges, and disulfide bonds

**Q13.3.6**

secondary, tertiary, and quaternary

**Q13.3.7**

No, a quaternary structure must have multiple subunits.

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