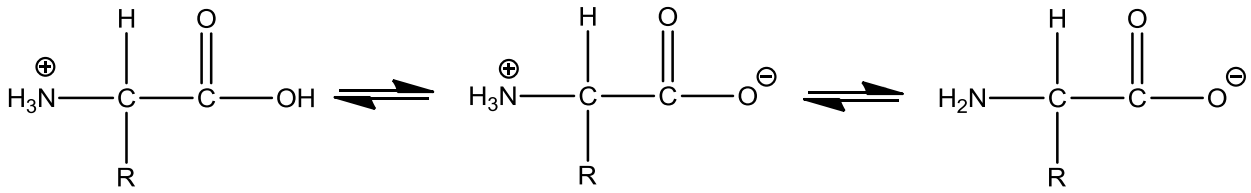
CHEM1611 Worksheet 13 – Answers to Critical Thinking Questions

The worksheets are available in the tutorials and form an integral part of the learning outcomes and experience for this unit.

Model 1: Amino Acids

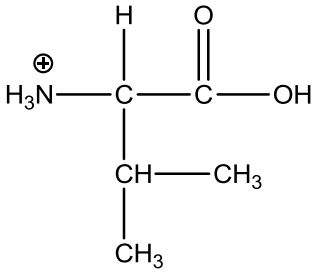
1. See below. The zwitterion has no overall charge.



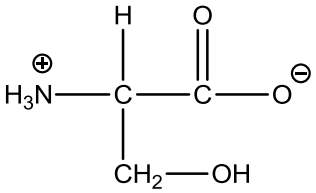
acidic **neutral** **basic**

+1 **0** **-1**

2. (a) Both groups are protonated;



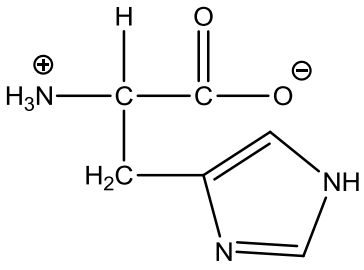
(b) The amine group is protonated and the acid group is deprotonated.



3. At the isoelectric point, pI = 5.66.

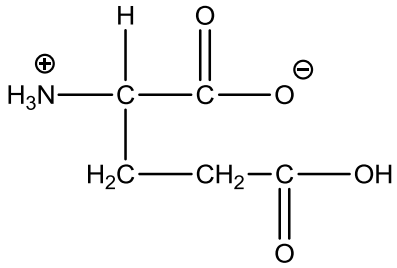
Model 2: Amino Acids with Acidic and Basic Side Chains

1. The pH is higher than the pK_a values of the acid group and the side chain so both will be deprotonated. The pH is lower than the pK_a of the α-NH_2 group so it will be protonated. This leads to the structure below.



2. No. The α-NH_2 group is more basic than the side chain so will be protonated first.

3. The pH is higher than the pK_a value of the α-COOH group acid group so it will be deprotonated. The pH is lower than the pK_a values of the side chain and the α-NH_3^+ group so both will be protonated. This leads to the structure below.

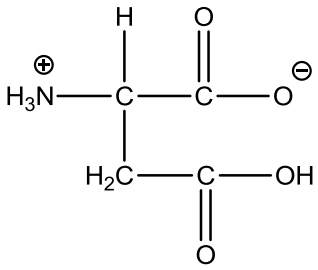


4. No. The α-COOH group is more acidic so will be deprotonated first.

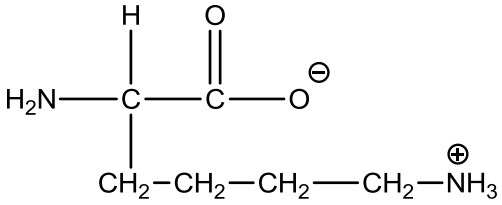
5. (a) histidine; pI = 7.64 (b) glutamic acid; pI = 2.98

6. Calculate the pI value for the two amino acids below and draw the structure of their zwitterions.

(a) pI = 2.98

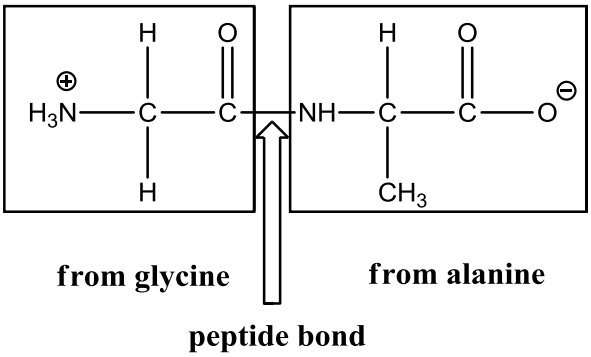


(b) pI = 9.74.



Model 3: Formation of Peptides

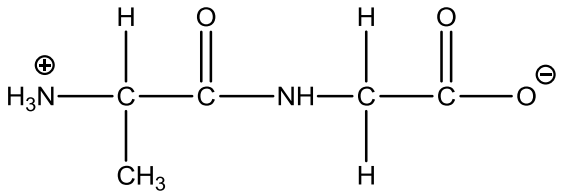
1. See below.



2. See above.

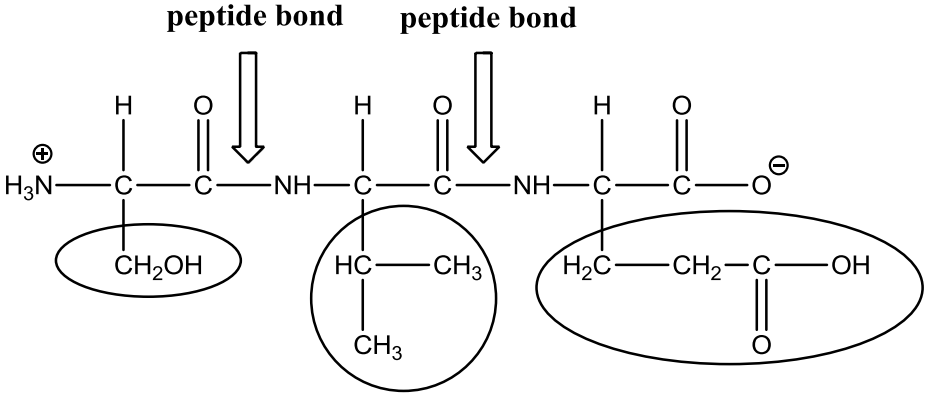
3. See above.

4. No. See structure below.



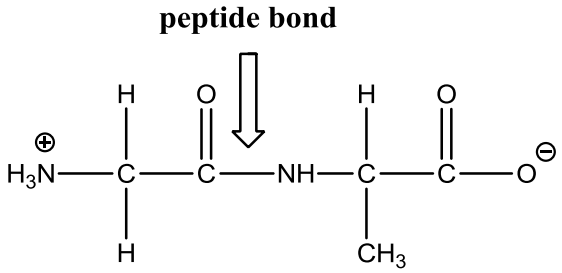
alanylglycine or ala-gly

5. The three amino acids are serine, valine and glutamic acid.



Model 4: Reactions of Amino Acids and Peptides

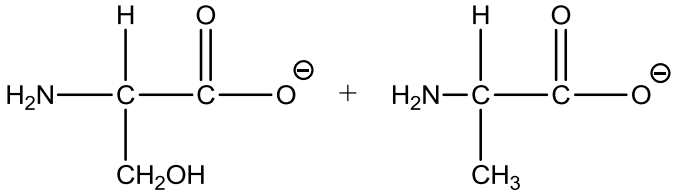
1. See below.



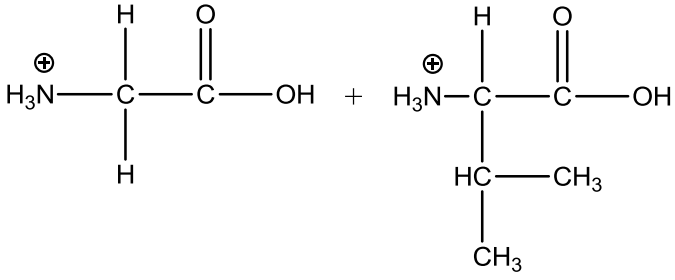
2. The reaction conditions are strongly basic.

3. Draw the products of the hydrolysis reactions below.

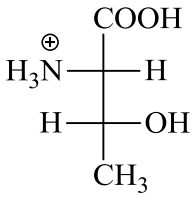
(a) See below. In the strongly basic conditions, the groups are deprotonated.

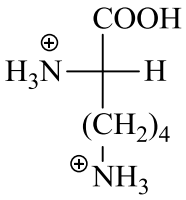


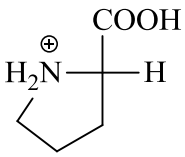
(a) See below. In the strongly acidic conditions, the groups are protonated.

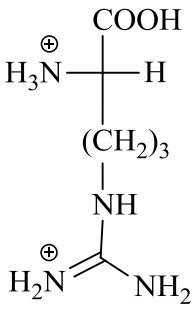


4. See below.


COOH
H3N
H
H
OH
CH3


COOH
H3N
H
(CH2)4
NH3


COOH
H2N
H


COOH
H3N
H
(CH2)3
NH
H2N
NH2