

Student Name : _____

2014-01-31

Student ID : _____

Instructions:

Write neatly and clearly. Cross out with a single line any material you do not wish to have marked. Marks will be deducted for incorrect statements. Students must work independently and may not knowingly utilize resource materials or share resource materials with other students. Students may use pens, pencils, erasers and calculators only.

Electronic devices including cell phones, personal information managers and audio devices are prohibited.

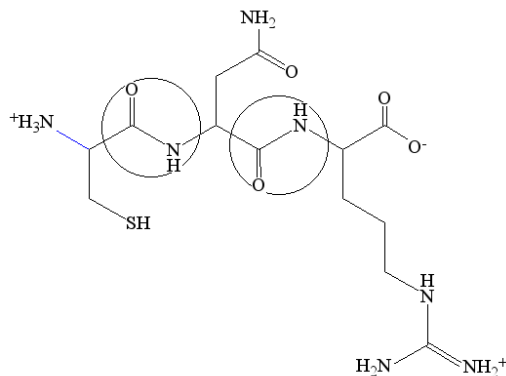
Question	Mark	Total Marks
1		8
2		9
3		5 -4
4		9
5		9
Total		40 39

(1) In the space provided, give brief definitions or unique descriptions of the following terms: (8 marks)

- (a) Isoelectric Point The pH at which the net charge is zero.
- (b) Polarity Dipole induced in the presence of an external electromagnetic field.
- (c) Salting In Initial increase in solubility due to increased charge shielding
- (d) Chromatography Stationary phase (ie. resin) retards the mobility of (selected) molecules in mobile phase.

(2) Consider the tripeptide sequence Cys-Asn-Arg. (9 marks)

- (a) Draw a stick diagram of the Cys-Asn-Arg tripeptide at pH 5.0.



1 mark each for R-groups ... 3

1 mark for correct charges ... 1

1 mark for main-chain ... 1

1 mark per peptide ... 2

- (b) Draw circles around each peptide bond in your stick diagram above.

(Note: Take care to only circle those atoms that contribute to a peptide bond's special properties)

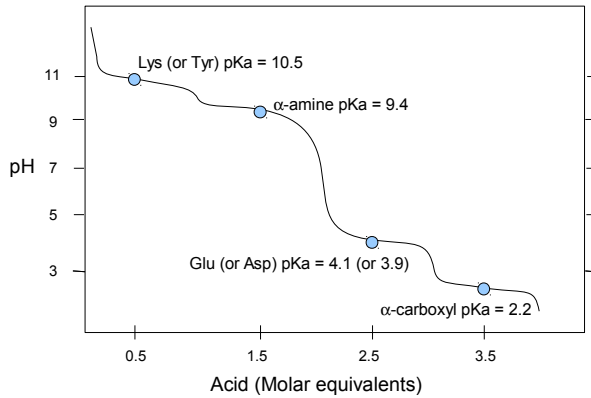
- (c) Does this tripeptide absorb UV-radiation? Why or why not?

No. It does not contain aromatic residues.

(3) Fill in the blanks with an appropriate term or short phrase. (5 marks)

- (a) Amino acids polymerize via a condensation reaction.
- (b) The R-group and α -amine of proline are covalently attached.
- (c) The full (proper) name of the Ile-Trp dipeptide is isoleucyltryptophan.
- (d) Methionine and cysteine are the only amino acids that contain sulfur.

(4) The following is a titration curve for an unknown tripeptide (ie. 3 residues in length) . (9 marks)



1 mark for each R group ... 2

1 mark for main-chain groups ... 1

(a) On the figure above, identify the R-group or functional group that gives rise to each significant transition.

(b) What can you conclude regarding the identity of the residues of the unknown tripeptide?

Tripeptide contains 1 Lys (or Tyr), 1 Glu (or Asp) and 1 non-ionizable residue (polar uncharged or non-polar)

(b) Calculate the isoelectric point of the unknown tripeptide. Show your work!!

Lys-Glu-X (as example of how marks are awarded. Any of above tripeptides will be considered)

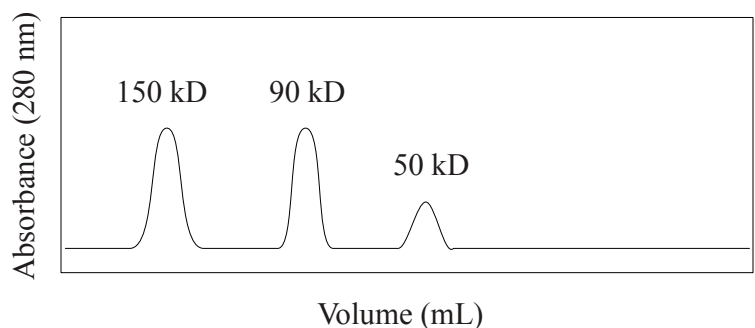
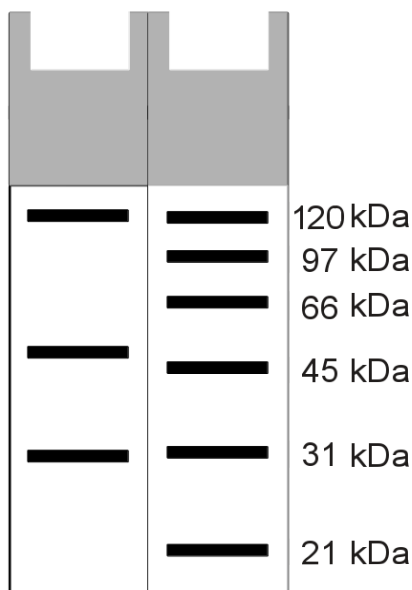
Ionization state of each R- or functional group at pH 7.0:

Lys (protonated; +1) α-amine (protonated; +1), Glu (deprotonated; -1), α-carboxyl (deprotonated; -1)

Net Charge = 0 $pI = (4.1 + 9.4)/2 = 6.75$

(for Lys, Asp pI = 6.65; Tyr, Glu pI = 3.15; Tyr, Asp pI = 3.05)

(5) You have been given an unknown protein sample and have successfully ran two separate experiments. First, you performed an SDS-PAGE (below left) using a small quantity of your unknown sample. You then ran a size-exclusion chromatography experiment (below right) and determined the molecular mass of the sample in each peak. Answer the following questions using this information. (9 marks)



(Note: Left-hand lane contains unknown protein sample and Right-hand lane contains a mixture of polypeptides of known molecular weight.)

a) How many proteins are present in your unknown sample?

At least 3 1 mark

b) How many unique polypeptide chains are in your unknown sample?

At least 3 1 mark

c) How many proteins in your sample have quaternary structure?

At least 2 1 mark

(1 mark for 'at least' in parts a-c) 1 mark

d) For each protein with quaternary structure, identify its polypeptide composition.

150 kD SEC protein must be composed of 1x 120 kD polypeptide + 1x 30 kD polypeptide

90 kD SEC protein must be composed of 3x 30 kD polypeptide 3 marks

e) If all the proteins in your unknown sample bind to a anion exchange chromatography resin at pH 7.0, what can we conclude about their isoelectric points?

Binding at pH 7.0 indicates the proteins are anionic at pH 7.0 2 marks

pI must be less than 7.0