

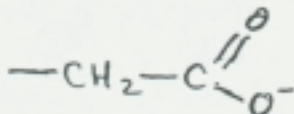
**Problem 2.** (28 points total).

Consider a short polypeptide with the following amino acid sequence: MARYLAND.

- (a) (4 pts) Write the sequence of this peptide using the 3-letter abbreviations for the amino acids.

Met-Ala-Arg-Tyr-Leu-Ala-Asn-Asp

- (b) (4 pts) Draw the structure of the **side chain** of the C-terminal residue (the residue at the carboxyl terminus) of this polypeptide at pH 7.0?



- (c) (8 pts total, 2 pts each) Indicate the total charge (in the units of electron charge) of the predominant species in solution with the following pH values:

pH = 2.8: +1

pH = 7.0: 0

pH = 11.0: -2

pH = 14.0: -3

- (d) (6 pts) Determine the isoelectric point (pI) for this peptide.

$$pI = (pK_2 + pK_R) / 2 \approx 6.73$$

here  $pK_2 \approx 9.21$  is  $pK_a$  for the amino-terminal  $\alpha\text{-NH}_3^+$  group

$pK_R = 3.65$  is  $pK_a$  for Asp side chain  $\text{COOH}$  group

- (f) (2 pts) Write the amino acid sequence of the two peptide fragments that you will obtain after treating it with Chymotrypsin that cleaves preferentially on the carboxyl site of aromatic residues? The only aromatic residue in this peptide is Y (Tyr), hence we get: MARY and LAND

- (g) (4 pts) Which of the two column chromatography methods, ion-exchange or gel filtration, would be your best choice for the separation of these cleavage products? Explain why.

Ion-exchange.

Take advantage of the difference in the charges of the two fragments: the side chain of Arg is positively charged at  $\text{pH} < 12.5$ ; while the side chain of Asp is negatively charged at  $\text{pH} > 3.65$ . Using gel filtration will be difficult because the fragments are similar in size.