

Name:

BIO 375: Biochemistry – Fall 2026
Problem Set 2 – Amino acids (10 points)
(Due Thursday, 9/17/26, in class)

Table 1: Dissociation constants for amino acids

Amino Acid	pK ₁ (α -COOH)	pK ₂ (α -NH [±])	pK _R (R-group)
Alanine	2.3	9.7	---
Arginine	2.2	9.0	12.5
Asparagine	2.0	8.8	---
Aspartate	1.9	9.6	3.7
Cysteine	2.0	10.3	8.2
Glutamine	2.2	9.1	---
Glutamate	2.2	9.7	4.3
Glycine	2.3	9.6	---
Histidine	1.8	9.2	6.0
Isoleucine	2.4	9.7	---
Leucine	2.4	9.6	---
Lysine	2.2	9.0	10.5
Methionine	2.3	9.2	---
Phenylalanine	1.8	9.1	---
Proline	2.0	11.0	---
Serine	2.2	9.2	---
Threonine	2.1	9.6	---
Tyrosine	2.2	9.1	10.1
Tryptophan	2.4	9.4	---
Valine	2.3	9.6	---

Name:

Please show all your work

Questions:

1. For the following tripeptides:

a) K-H-Y b) S-L-R

i) write the structural formulae in the *fully protonated* forms

ii) write the pK_a values for each dissociable H⁺ (refer to the table on page 1)

iii) calculate the pI of each tripeptide

2. Cysteine has three titratable groups with pK_{a1} (α -COOH) at 2.0, pK_{a2} (α -NH₃⁺) at 10.3, and pK_R (-SH) at 8.2.

a). What are all the possible ionic forms of this molecule?

b). Determine its pI.

c). What is its predominant structure at physiological pH of 7.4?

d). Draw its titration curve.

3. A solution contains a mixture of three tripeptides, YRS, EMF, and DPK.

a). Draw the chemical structure of the tripeptides in their fully protonated form.

b). Determine the pI of each.

c). At which pH value (2.0, 6.0, or 13.0) would electrophoresis provide the best resolution of the three tripeptides in the mixture? Please show your reasoning i.e. how you arrived at your conclusion.

d). Draw the theoretical titration curve of YRS.