Predicting Peptide Structures and Charges as a Function of pH

For each of the following peptides, draw their Lewis structures at the indicated pH values and calculate the net charge on the peptide.\(^1\)\(^2\)

1. Ala-Phe-Tyr-Lys  pH = 5.0
2. Cys-His-Arg   pH = 9.5
3. Glu-Asn-Thr-Trp   pH = 2.0
4. Tyr-His-Asp-Arg-His   pH = 9.1
5. Pro-Hyp-Gly-Cys-Ser   pH = 10.3
6. Ile-Pro-Lys-Gly-Asp   pH = 6.4

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\(^1\) Note: Not for 3785 this year, but appropriate for MCAT, DCAT, GRE, etc., related studying: For each peptide, predict its isoelectric point, pl (i.e., this is the pH value at which it would have a net charge of 0) and draw its structure at this pH.

\(^2\) Note: Hyp = Hydroxyproline
1st Problem Set

1. 

\[
\text{pH} = 5.0 \\
\text{net charge} = +1
\]

\[ pK_a = 8.0 \]

\[ pK_a = 10.0 \]

\[ pK_a = 10.0 \]

\[ pK_a = 7.1 \]

\[ \text{pI} = 9.0 \text{ (i.e., the point at which the terminal amino group is deprotonated, but the Lys is not net)} \]

[Note: the top structure is drawn as a Lewis structure, while the bottom one is not.]
pH = 9.1

net charge = -1

pI = 7.3

net charge = 0
5. $\text{pH} = 10.3$

\[ \text{net charge} = -2 \]

$pI = 6$

\[ \text{net charge} = 0 \]

$pI = 6.4$

\[ \text{net charge} = 0 \]

This is at the isoelectric point $pI = 6.4$