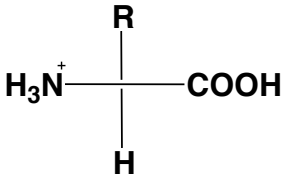
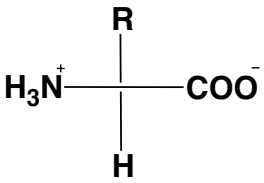
CONCEPT: ISOELECTRIC AND ISOIONIC POINT

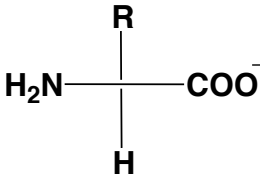
Isoelectric or *isoionic* points represent the pH where a polyprotic acid doesn't migrate to an electric field because it's neutral.



Below Isoelectric Point



At Isoelectric Point



Above Isoelectric Point

At the isoionic point the polyprotic acid exists as an intermediate and so we can utilize past equations to determine $[H^+]$.

Diprotic Acid

$$[H^+] = \sqrt{\frac{K_{a_1}K_{a_2}F + K_{a_1}K_w}{K_{a_1} + F}}$$

Polyprotic Acid

H_2A^-

$$[H^+] \approx \sqrt{\frac{K_{a1}K_{a2}[\,]_0 + K_{a1}K_w}{K_{a1} + [\,]_0}}$$

HA^{2-}

$$[H^+] \approx \sqrt{\frac{K_{a2}K_{a3}[\,]_0 + K_{a2}K_w}{K_{a2} + [\,]_0}}$$

The *isoelectric* point is the pH where $[H_2A] = [A^-]$ and therefore the average charge is equal to zero.

Diprotic Acid

$$pH = \frac{1}{2}(pK_{a_1} + pK_{a_2})$$

Polyprotic Acid

$$pH = \frac{1}{2}(pK_{a_1} + pK_{a_2})$$

$$pH = \frac{1}{2}(pK_{a_2} + pK_{a_3})$$

PRACTICE: ISOELECTRIC AND ISOIONIC POINT CALCULATIONS 1

EXAMPLE 1: Calculate the isoelectric and isoionic pH of 0.025 M glutamine. pK_{a1} = 2.19, pK_{a2} = 9.00.

EXAMPLE 2: Draw the structures and charge of aspartic acid at pH = 9.82.

PRACTICE 1: Calculate the pI value for histidine. pK_{a1} (carboxyl group) = 1.60, pK_{a2} (ammonium group) = 9.28, pK_{a3} (R-group) = 5.97.

PRACTICE 2: Calculate the pI value for gluatamic acid. pK_{a1} (carboxyl group) = 2.16, pK_{a2} (ammonium group) = 9.96, pK_{a3} (R-group) = 4.30.