Acid/Base Chemistry How many Chemicals are you putting into the container?

ONE

Strong Acid

Know your strong acids: HNO_3, H_2SO_4, $HClO_4$, HCl, HI HBr

Donates H^+ to water 100 % to make H_3O^+ and a conjugate.

$HX + H_2O \rightarrow H_3O^+ + X^-$

$[H_3O^+]$ = M of the original acid

Calculate pH:

$pH = -\log[H_3O^+]$

Strong Base

Know your strong Bases: Group 1 and Group 2 Hydroxides

Dissociates 100 % into Cation and OH^-. Don't forget to balance. No H_2O in equation

$MOH \rightarrow M^+ + OH^-$

$[OH^-]$ = M of original base x coefficient on OH^-

Calculate pH:

$pH = 14-(-\log [OH^-])$

Weak Acid

Any other compound that has H^+ as the cation and not a strong acid

Donates H^+ to water creating an equilibrium, making H_3O^+ and a conjugate.

$HX + H_2O \rightleftharpoons H_3O^+ + X^-$

$K_a = [H_3O^+][X^-]/[HX]$

Set up an ICE Chart, use K_a and law of mass action to solve for X . Must work in M

$X= [H_3O^+]$

Calculate pH:

$pH= -\log[H_3O^+]$

Salt

A neutral ionic compound without H^+ for cation or OH^- for anion

Dissociate salt into cation and anion. Look at each part.

Cations (not group 1 or 2) act as weak acids

Anions act as weak bases (not I^-, Br^-, Cl^-, NO_3^- or ClO_4^-)

Use

$K_a \bullet K_b = K_w$

to get K value for ICE chart!

**Salts between group 1 and group 2 cations and I^-, Br^-, Cl^-, NO_3^- or ClO_4^- anions are neutral salts pH = 7

Weak Base

An organic molecule that ends in N, NH or NH_2

Steals an H^+ from water creating an equilibrium, making OH^- and a conjugate

$B + H_2O \rightleftharpoons BH^+ + OH^-$

$K_b = [BH^+][OH^-]/[B]$

Set up an ICE Chart, use K_b and law of mass action to solve for X . Must work in M **$X= [OH^-]$**

Calculate pH:

$pH= 14- (-\log[OH^-])$

Acid/Base Chemistry How many Chemicals are you putting into the container?

TWO

What are the two chemicals?

WEAK acid/base conjugate pair Conjugate is often in a salt (ex. HF and LiF or NH_3 and NH_4Cl)

Strong with a weak (ex. Strong acid with weak base). This is what many titrations are

2 strong (ex. strong acid with strong base) One type of titration

BUFFER

Common ion effect

Calculate pH: Use Henderson-Hasselbalch

Identify acid part of the buffer and get K_a of that weak acid

pH = pKa + log B/A

- B/A ratio can be in moles or M as long as volume does not change (not mixing two solutions together)
- pH buffer ≈ pKa More base pH>pKa, more acid pH<pKa
- Buffering Capacity depends on moles of each part

Write Neutralization Equation – **Completion Reaction**

Do BCA Table

Must be worked in **moles (MxL)**

There is a limiting reactant (fewer moles) – change in table

Look at "A" line on BCA.

Before Equivalence pt in titration

If OH^- or H_3O^+ is the limiting reactant, you have a **BUFFER**

At Equivalence pt. in a titration, there is no LR or ER. pH depends on the conjugate (product) present. Cation → pH < 7. Anion → pH > 7

After equivalence pt. in titration

If OH^- or H_3O^+ is the excess reactant, convert to M using total volume

Calculate pH using:

$pH = -\log[H_3O^+]$

$pH = 14-(-\log[OH^-])$

Bases react with Acids. Never 2 bases or 2 acids. OH^- (strong base) or H_3O^+ (strong acid)are reactants. Water is a product

$OH^- + HX \rightarrow H_2O + X^-$

$H_3O^+ + B \rightarrow H_2O + BH^+$

Write Neutralization Equation – **Completion Reactions**

$H_3O^+ + OH^- \rightarrow H_2O + H_2O$

NEVER A BUFFER

Do BCA Table

Must be worked in **moles**

There is a limiting reactant (fewer moles) – change in table

Excess reactant on "A" line controls pH. Convert back to molarity using total volume

Acid/Base Chemistry How many Chemicals are you putting into the container?

Three

Adding a strong acid or base to a pre-existing buffer

Is the strong being added a strong base? (LiOH, NaOH, KOH)

Is the strong being added a strong acid? HI, HBr, HCl, HNO_3 $HClO_4$

Write a net Neutralization Equation of **strong base (OH^-)** with the **ACID** component of the buffer – **Completion Reactions**

$OH^- + HX \rightarrow H_2O + X^-$

$OH^- + BH^+ \rightarrow H_2O + B$

Write a net Neutralization Equation of **strong acid (H_3O^+)** with **the BASE** component of the buffer – **Completion Reactions**

$H_3O^+ + B \rightarrow H_2O + BH^+$

$H_3O^+ + X^- \rightarrow H_2O + HX$

Do BCA Table

Must be worked in **moles** **(M X L)**

Since there are 3 chemicals present, there will be three numbers on the "B line" of the table

There is a limiting reactant (fewer moles of reactant). That quantity is the change in BCA table

Look at "A" line on BCA.

If OH^- or H_3O^+ is the limiting reactant, you have a **BUFFER**

Calculate pH using:

pH = pKa + log B/A

If OH^- or H_3O^+ is the excess reactant, convert to M using total volume

Calculate pH using:

pH = -log[H_3O^+]

pH= 14-(-log[OH^-])