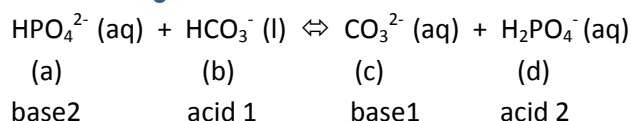


Lecture 19: Acid-Base Equilibrium

**Clicker Question:**



**Question 1:** ID the acid/base on the left and their conjugate base/acid on the right

Answer: **D**

(b) is an acid (gives up  $\text{H}^+$ )

(c) is its conjugate base

(a) is a base (receives an  $\text{H}^+$ )

(d) is its conjugate acid

**Question 2:** Does the equilibrium lie primarily to the left or to the right?

Answer: **B**

$K_a$  values given are the acid ionization constants

they measure the strength of the acids (so the  $K_a$  value for  $\text{HPO}_4^{2-}$  doesn't need to be considered)

the larger the  $K_a$  value the stronger the acid

the stronger the acid, the more the equilibrium will go to the other side

$\text{H}_2\text{PO}_4^-$  is the stronger of the 2 acids and is on the right

so the equilibrium lies to the left

**pH and pOH**

1. "p" just stands for "the negative log base-10 of"
  - a. so  $\text{pH} = -\log_{10}[\text{H}^+]$
2. pH measures the concentration of  $[\text{H}^+]$  ions
3. pOH measures the concentration of  $[\text{OH}^-]$  ions
  - a. pH scale of 0 (acidic) to 14 (basic)
    - i. pH of 7 (neutral) means  $[\text{H}^+] = [\text{OH}^-]$
  - b. there are pH values lower than 0 and higher than 14 but they are so corrosive or caustic they often eat through normal containers, so they're not commonly measured
4.  $\text{pH} + \text{pOH} = 14$ 
  - a. so once you find either pH or pOH you can find the other by subtracting it from 14

### 3 types of acid-base problems

1. Predict the pH
  - a. Strong acid/base
    - i. Completely dissociates so the concentration of  $[H^+]$  or  $[OH^-]$  will just be the amount of the acid/base you started with
    - ii. Strong acids include:
      1. HCl, HBr, HI (but not HF which is weak)
      2.  $H_2SO_4$
      3.  $HNO_3$
      4.  $HClO_4$
    - iii. Strong bases include:
      1. Most metal cations with  $OH^-$  ions
    - iv.  $K_w (1.0 \times 10^{-14}) = [H^+] \times [OH^-]$  is the water autoionization equilibrium taking the negative log of both sides gives
$$14 = pH + pOH$$
  - b. Weak acid/base
    - i. Solve as you would with I C E charts
    - ii.  $K_a$  is usually given
2. Equilibrium
  - a. Given pH of a solution
  - b. Figure out how much acid/base or salt must have been added to water to make the that given pH
3. Titration
  - a. Given a solution of unknown acid/base concentration
  - b. Neutralize with known amount of base/acid to figure out unknown concentration