Clicker Question:
HPO$_4^{2-}$ (aq) + HCO$_3^-$ (l) ⇋ CO$_3^{2-}$ (aq) + H$_2$PO$_4^-$ (aq)
(a) base2 acid 1 (b) (c) (d) base1 acid 2

**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 H$^+$)
(c) is its conjugate base
(a) is a base (receives an 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 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
H$_2$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 pH = $-\log_{10}[H^+]$
2. pH measures the concentration of [H$^+$] ions
3. pOH measures the concentration of [OH$^-$] ions
   a. pH scale of 0 (acidic) to 14 (basic)
      i. pH of 7 (neutral) means [H$^+$] = [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. pH + 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. H₂SO₄
         3. HNO₃
         4. HClO₄
      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