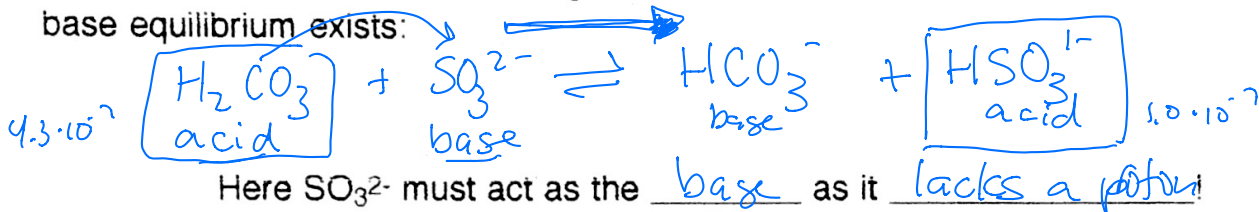


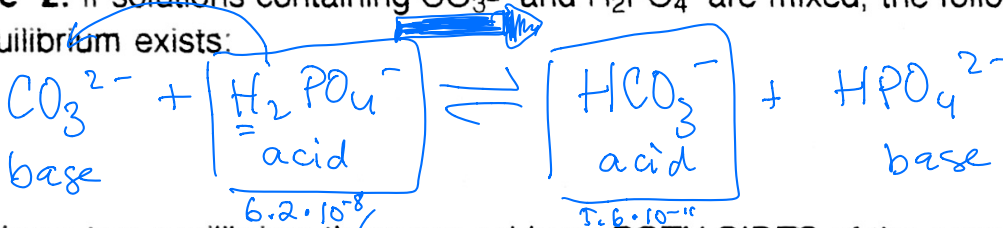
CHEMISTRY 12
 ACID BASES UNIT
 Lesson #10

THE RELATIVE STRENGTHS OF ACIDS AND BASES

Example 1. If solutions containing H_2CO_3 and SO_3^{2-} are mixed, the following acid base equilibrium exists:



Example 2: If solutions containing CO_3^{2-} and H_2PO_4^- are mixed, the following acid-base equilibrium exists:



In the above two equilibrium there are acids on BOTH SIDES of the equation, just as there are bases on both sides of the equation. However, in a BRONSTED-LOWRY acid-base equilibrium the side of the equilibrium that is favoured is the side with the weaker acid -----!!!! (weaker base)

arm wrestling analogy

Therefore, in **Example 1** the side of the equilibrium that is favoured is determined by comparing the strengths of the TWO ACIDS. Because HSO_3^- is a weaker acid than H_2CO_3 , the PRODUCTS are favoured.

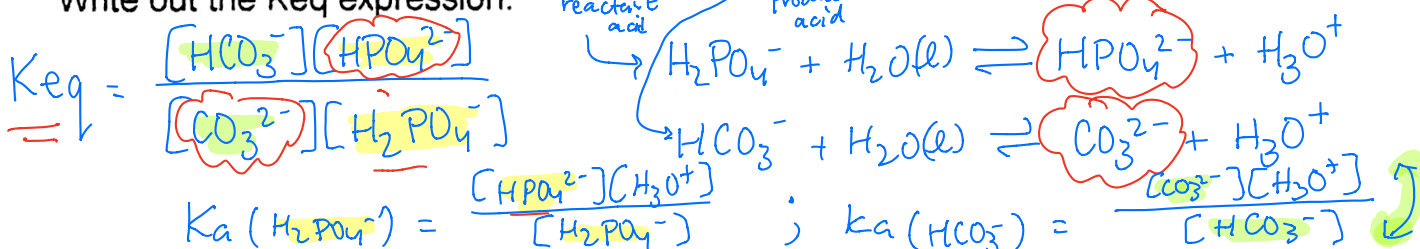
In **Example 2** the side of the equilibrium that is favoured is also determined by comparing the strengths of the TWO ACIDS. Because HCO_3^- is a weaker acid than H_2PO_4^- , the products are favoured.

Here is another way of determining which side is favoured in a Bronsted-Lowry acid-base equilibrium:

Using the chemical equation from **Example 2:**



Write out the Keq expression:



The Keq expression can be RE-WRITTEN AS:

$$K_{eq} = \frac{[H_2PO_4^-][H_3O^+]}{[H_3PO_4]} \cdot \frac{[HCO_3^-]}{[CO_3^{2-}][H_3O^+]} \Rightarrow$$

$$= \frac{K_a(\text{reactant acid})}{1/K_a(\text{product acid})}$$

OR SIMPLY AS:

$$K_{eq} = \frac{H_2PO_4^-}{K_a(\text{reactant acid})} \cdot \frac{1}{K_a(\text{product acid})} \Rightarrow \frac{6.2 \cdot 10^{-8}}{5.6 \cdot 10^{-11}}$$

RECALL:

If the Keq value = 1

Both sides equally favoured

If the Keq value > 1

Product side favoured

If the Keq value < 1

reactant side favoured

$$= \boxed{1.1 \cdot 10^3}$$

Keq > 1

∴ Product

THE GENERIC Keq expression for acid-base equilibria is:

$$1.1 \cdot 10^3$$

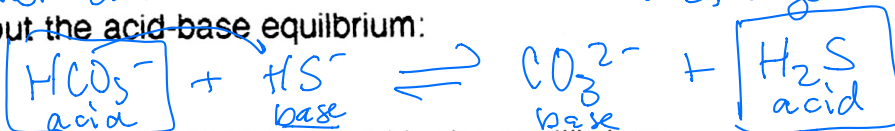
$$K_{eq} = \frac{K_a(\text{REACTANT ACID})}{K_a(\text{PRODUCT ACID})}$$

Example 3. When HS^- and HCO_3^- are mixed, does the resulting equilibrium favour the reactant or the products? $5.6 \cdot 10^{-11}$

1. Choose which of these two reactants is going to act as the acid.

Higher on the left hand side ∴ stronger acid

2. Write out the acid-base equilibrium:



3. Identify the TWO ACIDS involved in the equilibrium:

HCO_3^- acid reactant side; H_2S acid product side

a. Solve the problem using the WEAKER ACID rule

$$K_a(5.6 \cdot 10^{-11})$$

$$9.1 \cdot 10^{-8}$$

∴ Reactant side is favoured

b. Solve the problem using the Keq equation

$$K_{eq} = \frac{K_a(\text{reactant})}{K_a(\text{product})} = \frac{5.6 \cdot 10^{-11}}{9.1 \cdot 10^{-8}} = \boxed{6.2 \cdot 10^{-4}} \leftarrow \text{"small"}$$

Keq < 1 reactants are favoured!

SEATWORK/HOMEWORK: Exercises 38-46 in Hebden pg 131

PLO's: K8+K9