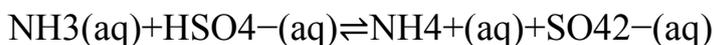


## Answer on Question #56394 – Chemistry General Chemistry

### Question:

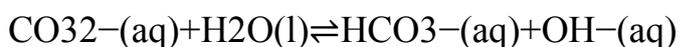
Predict whether each of the following reactions contains mostly reactants or products at equilibrium:

Part A



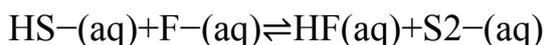
- a. the solution contains mostly products at equilibrium
- b. the solution contains mostly reactants at equilibrium

Part B



- a. the solution contains mostly reactants at equilibrium
- b. the solution contains mostly products at equilibrium

Part C

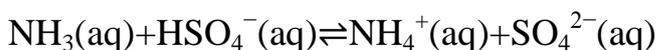


- a. the solution contains mostly reactants at equilibrium
- b. the solution contains mostly products at equilibrium

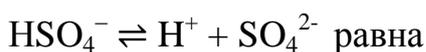
### Solution:

It is process of titration of strong acid ( $\text{H}_2\text{SO}_4$ ) the weak basis ( $\text{NH}_3$ ):

Part A



Dissociation constant of hydrosulphite ion on the equation:



$$K_a = \frac{[\text{H}^+][\text{SO}_4^{2-}]}{[\text{HSO}_4^-]} = 1.15 \cdot 10^{-2}$$

Constant of reaction of interaction of ammonia with water on the equation:



$$K_b = \frac{[\text{NH}_4^+][\text{OH}^-]}{[\text{NH}_3][\text{H}_2\text{O}]} = 1.76 \cdot 10^{-5}$$

The constant of balance of reaction A is equal

$$K_A = \frac{[NH_4^+][SO_4^{2-}]}{[NH_3][HSO_4^-]}$$

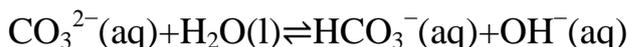
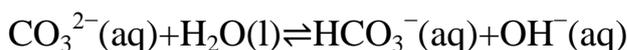
We will increase numerator and a denominator of fraction by ionic product of water  $K_w = [H^+][OH^-]$  and we will accept concentration of water equal 1:

$$K_A = \frac{[NH_4^+][SO_4^{2-}][H^+][OH^-]}{[NH_3][HSO_4^-][H^+][OH^-]} = \frac{[H^+][SO_4^{2-}]}{[HSO_4^-]} * \frac{[NH_4^+][OH^-]}{[NH_3][H_2O]} * \frac{1}{K_w [H_2O]} = \frac{K_b}{K_a} \frac{1}{K_w [H_2O]} =$$

$$\frac{1.76 * 10^{-5}}{1.15 * 10^{-2}} * \frac{1}{10^{-14}} = 1,53 * 10^{11} \gg 1$$

Answer: a. the solution contains mostly products at equilibrium.

Part B



The constant of balance of this reaction is equal

$$K = \frac{[HCO_3^-][OH^-]}{[CO_3^{2-}][H_2O]}$$

We will increase numerator and a denominator of fraction by equilibrium concentration of ions of hydrogen and we will accept concentration of water equal 1.

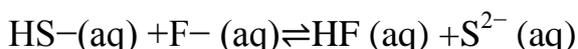
$$K = \frac{[HCO_3^-][OH^-][H^+]}{[CO_3^{2-}][H_2O][H^+]} = \frac{[HCO_3^-]}{[CO_3^{2-}][H^+]} * [OH^-][H^+] = K_w / K_a$$

$$K_a = 4.8 * 10^{-11}, K_w = 10^{-14}$$

$$K = 10^{-14} / 4.8 * 10^{-11} = 2.08 * 10^{-4} \ll 1$$

**Answer:** b. In equilibrium mix there will be generally initial reagents.

Part C

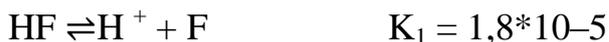


The constant of balance of this reaction is equal

$$K = \frac{[HF][S^{2-}]}{[F^-][HS^-]}$$

We will increase numerator and a denominator of fraction by equilibrium concentration of ions of hydrogen and we will accept concentration of water equal 1.

$$K = \frac{[HF][S^{2-}][H^+]}{[F^-][HS^-][H^+]} = \frac{[HCO_3^-]}{[CO_3^{2-}][H^+]} * [OH^-][H^+] = K_2/K_1$$



$$K = 2,5 \cdot 10^{-13} / 1,8 \cdot 10^{-5} = 1,39 \cdot 10^{-8} \ll 1$$

**Answer:** b. the solution contains mostly reactants at equilibrium