pH of Sulfuric Acid

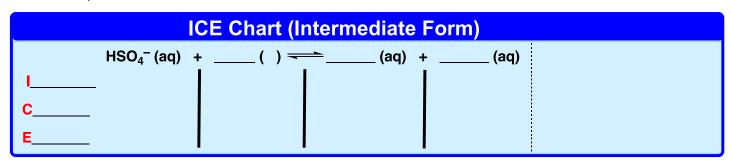
- Sulfuric acid represents the only _____ diprotic acid.
 - □ In terms of acidity, the 1st acidic proton dissociates _____ and the 2nd acidic proton only _____.

EXAMPLE: Calculate the pH of a 0.0550 M H_2SO_4 solution. $K_{a1} = 1.0 \times 10^3$ and $K_{a2} = 1.2 \times 10^{-2}$.

STEP 1: Use the Bronsted-Lowry definition to predict the products formed when H₂SO₄ reacts with ______.

□ H₂SO₄ completely dissociates initially, meaning [H₂SO₄] _____ [H₃O⁺] and the Intermediate Form.

STEP 2: Setup an ICE Chart for the Intermediate Form created in STEP 1 and react it with ______



STEP 3: Using the INITIAL ROW, place the amounts from STEP 1 for the Intermediate Form and [H₃O⁺].

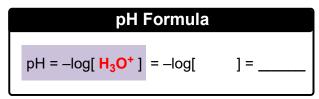
 \Box Place a <u>0</u> for the basic form.

STEP 4: We _____ reactants to _____ products.

 $\hfill \square$ Using the CHANGE ROW, place a _____ for the reactants and a _____ for the products.

STEP 5: Using the EQUILIBRIUM ROW, setup the equilibrium constant expression with <u>Ka2</u> and solve for _____.

STEP 6: To solve for pH add the [H₃O⁺] from STEPS 1 and 5 to determine its _____ concentration.



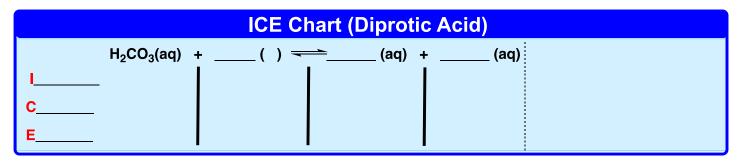
pH of Weak Diprotic Acids

• Utilize only _____ to calculate the pH of the acidic form of a weak diprotic acid.

EXAMPLE: Calculate the pH of a 0.115 M carbonic acid, H_2CO_3 , solution. $K_{a1} = 4.3 \times 10^{-7}$ and $K_{a2} = 5.6 \times 10^{-11}$.

STEP 1: Setup an ICE Chart for the weak diprotic acid that has it reacting with ______.

□ Use the Bronsted-Lowry definition to predict the products formed.



STEP 2: Using the INITIAL ROW, place the amount given for the weak diprotic acid.

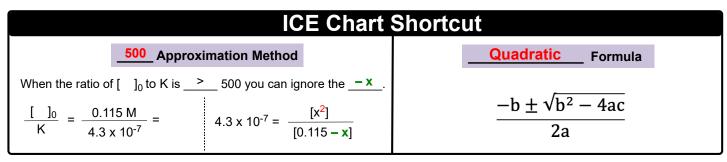
□ Place a ____ for any substance not given an initial amount.

STEP 3: We _____ reactants to _____ products.

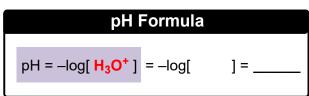
□ Using the CHANGE ROW, place a _____ for the reactants and a _____ for the products.

STEP 4: Using the EQUILIBRIUM ROW, setup the equilibrium constant expression with _____ and solve for ____.

□ Check if a shortcut can be utilized to avoid the _____ formula.



STEP 5: The _____ variable will equal [] and can be used to solve pH.

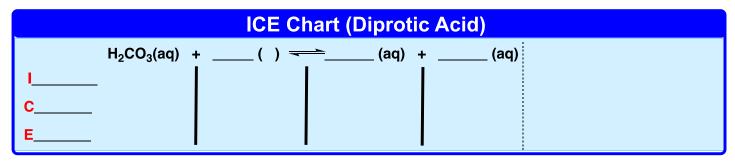


Calculate Concentration of the Basic Form

• Special Case: When given the initial $[H_2A]$ the $[A^2-]$ = the _____ value.

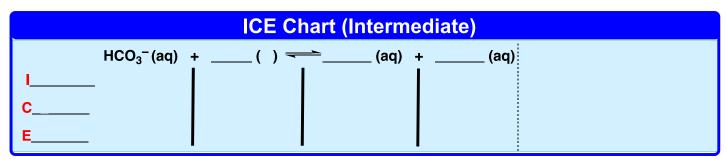
EXAMPLE: Determine the $[CO_3^{2-}]$ when given 0.115 M carbonic acid, H_2CO_3 , solution. $K_{a1} = 4.3 \times 10^{-7}$ and $K_{a2} = 5.6 \times 10^{-11}$.

STEP 1: Setup an ICE Chart to calculate the [HA-] and [H₃O+] using _____.



STEP 2: Setup another ICE Chart and using the INITIAL ROW, place the calculated amounts for [HA-] and [H₃O+].

 \Box Place a ____ for the [A²⁻].



STEP 3: We _____ reactants to _____ products.

 $\hfill \Box$ Using the CHANGE ROW, place a _____ for the reactants and a _____ for the products.

STEP 4: Using the EQUILIBRIUM ROW, setup the equilibrium constant expression with _____ and solve for ____.

□ Check if a shortcut can be utilized to avoid the _____ formula.

PRACTICE: Which of the following diprotic acid would produce the most acidic solution when dissolved?

a) $0.200 \text{ M H}_2\text{SO}_3 \text{ (K}_{a1} = 1.6 \text{ x } 10^{-2} \text{ ; K}_{a2} = 4.6 \text{ x } 10^{-5} \text{)}$

b) 0.200 M H₃PO₄ ($K_{a1} = 7.5 \times 10^{-3}$; $K_{a2} = 6.2 \times 10^{-8}$; $K_{a3} = 4.2 \times 10^{-13}$)

c) 0.200 M H_2CO_3 ($K_{a1} = 4.3 \times 10^{-7}$; $K_{a2} = 5.6 \times 10^{-11}$)

d) 0.200 M H_2S (K_{a1} = 8.9 x 10^{-8} ; K_{a2} = 1.0 x 10^{-19})

e) $0.200 \text{ M HC}_9\text{H}_7\text{O}_4 \text{ (K}_{a1} = 3.3 \text{ x } 10^{-4}\text{)}$

PRACTICE: Determine the pH of 0.115 M Na₂S. Hydrosulfuric acid, H_2S , possesses $K_{a1} = 1.0 \times 10^{-7}$ and $K_{a2} = 9.1 \times 10^{-8}$.