

Today ♥ Feb 14: Review sections 1-10, 12 Sections 15.11 and 15.13

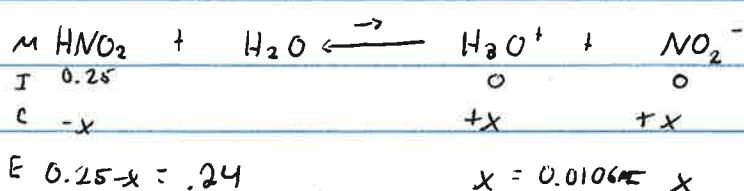
Friday: Sections 15.14 and 15.15

Sunday: Problem club with Ali

Monday: catch up, review

What is the conc of all species and the pH of a 0.25M HNO_2 sol'n? ^(weak acid)

$$K_a^{\text{HNO}_2} = 4.5 \times 10^{-4}$$



$$K_a = \frac{[\text{H}_3\text{O}^+][\text{NO}_2^-]}{[\text{HNO}_2]} = 4.5 \times 10^{-4}$$

$$K_a = \frac{x^2}{0.25-x} = 4.5 \times 10^{-4}$$

$$K_a = \frac{x^2}{0.25} = 4.5 \times 10^{-4}$$

400 Rule: $\frac{0.25}{4.5 \times 10^{-4}} = 556 > 400 \checkmark$ (x is small)

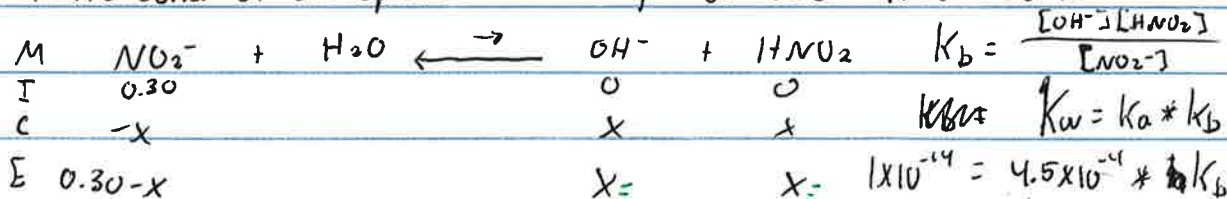
$$x^2 = .0001125$$

$$[\text{H}_3\text{O}^+] = 0.0106\text{M}$$

$$x = 0.0106$$

$$\text{pH} = -\log(0.0106\text{M}) = \boxed{1.97}$$

What is the conc. of all species and the pH of 0.30M NO_2^- sol'n?



$$K_b = \frac{[\text{OH}^-][\text{HNO}_2]}{[\text{NO}_2^-]}$$

$$K_w = K_a * K_b$$

$$2.58 \times 10^{-6}\text{M} \cdot 2.58 \times 10^{-6}\text{M} \cdot \frac{1 \times 10^{-14}}{4.5 \times 10^{-4}} = K_b$$

$$K_b = \frac{[\text{OH}^-][\text{HNO}_2]}{[\text{NO}_2^-]} = 2.2 \times 10^{-11}$$

$$K_b = \frac{x^2}{0.30} = 2.2 \times 10^{-11}$$

$$x^2 = 6.67 \times 10^{-12}$$

$$x = 2.58 \times 10^{-6}$$

$$[\text{OH}^-] = 2.58 \times 10^{-6}\text{M}$$

$$\text{pOH} = -\log(2.58 \times 10^{-6})$$

$$\text{pOH} = 5.59$$

$$K_b = 2.2 \times 10^{-11}$$

-very small so passes the 400 rule

$$\text{pH} = 14 - 5.59$$

$$\boxed{\text{pH} = 8.41}$$

strongest weak acid

ACID
STRENGTH
INCREASES

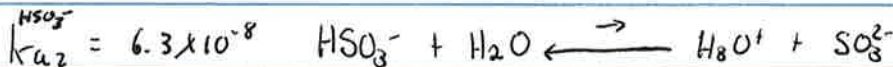
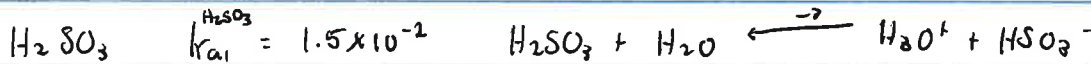
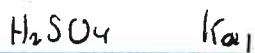
K_a	K_b	pK_a	pK_b
4.5×10^{-4}	2.2×10^{-11}	3.35	10.66
6.5×10^{-6}	1.54×10^{-10}	4.19	9.81
1.8×10^{-5}	5.56×10^{-10}	4.74	9.25
3.6×10^{-8}	2.86×10^{-7}	7.46	6.54
5.6×10^{-10}	1.79×10^{-5}	9.25	4.75
4.9×10^{-10}	2.04×10^{-5}	9.31	4.69

base strength increases

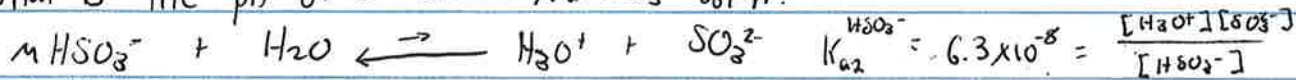
$pK_a = -\log K_a$ $K_a = 10^{-pK_a}$

small $pK_a =$ stronger acid

Polyprotic acids



What is the pH of a 0.10M $Na^+ HSO_3^-$ sol'n?



I .10M

C -x

E .10-x

0 0

+x +x

x x

$6.3 \times 10^{-8} = \frac{x^2}{.10-x}$

400 Rule: $\frac{.10}{6.3 \times 10^{-8}} = 1.59 \times 10^6$ ✓

$6.3 \times 10^{-8} = \frac{x^2}{.10}$

$6.3 \times 10^{-9} = x^2$

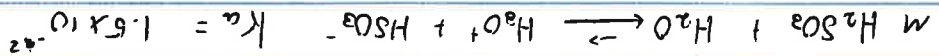
$x = 7.94 \times 10^{-5}$

$[H_3O^+] = 7.9 \times 10^{-5} M$

$pH = -\log(7.9 \times 10^{-5} M)$

$pH = 4.10$

What is the pH of a 0.10M H2SO3 solution?



400 rule: $\frac{1.5 \times 10^{-2}}{0.10} = 0.15$ **X**

$$1.5 \times 10^{-2} = \frac{x^2}{0.10 - x}$$

$$(1.5 \times 10^{-2})(0.10 - x) = x^2$$

$$x^2 = 0.0015 - 0.015x$$

$$0 = x^2 + 0.015x - 0.0015$$

$$x = 3.19 \times 10^{-2}$$

(not negative)

check: $K_a = \frac{(3.19 \times 10^{-2})^2}{0.10 - 3.19 \times 10^{-2}} = 1.5 \times 10^{-2}$



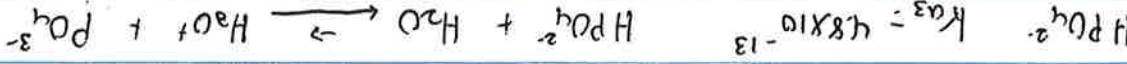
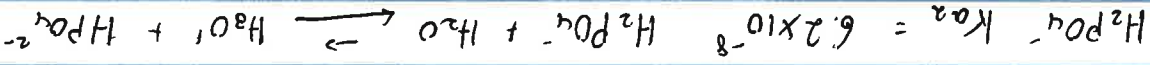
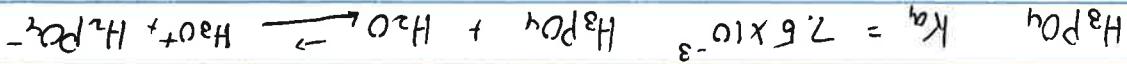
400 rule: $\frac{6.3 \times 10^{-8}}{0.0319} = 5.06 \times 10^{-5}$ ✓ passes

$$\frac{[H_3O^+][SO_3^{2-}]}{[HSO_3^-]} = 6.3 \times 10^{-8}$$

$$\frac{y \cdot 0.0319 - y}{0.0319 - y} = 6.3 \times 10^{-8}$$

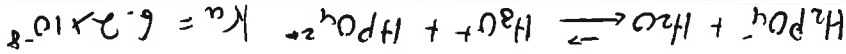
$$y = 6.3 \times 10^{-8}$$

concentration of H3O+ did not change so pH is the same (pH = 1.50)



Is H2PO4- a better weak acid or weak base?

Try it as a weak acid:



try it as a weak base:



Ka is bigger so it is a better weak acid.

wa wb
H2PO4- H2PO4-
H2PO4- HPO4^2-
H2PO4- PO4^3-