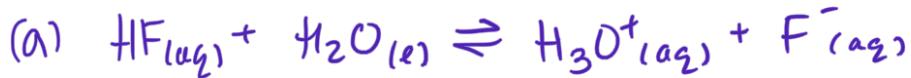


KEY

Intro to Acid/Base

Reaction 1: Consider a 0.342 M HF solution, the K_a of HF is 6.6×10^{-4} .

- What is the chemical reaction?
- What is the equilibrium expression?
- What is the concentration of F^- , H_3O^+ , OH^- , and HF at equilibrium?
- What is the pH and pOH of the solution?



(b) $K_a = \frac{[H_3O^+][F^-]}{[HF]}$

	HF	H_3O^+	F^-
I	0.342	0	0
C	-x	+x	+x
E	$0.342-x$	x	x

$$6.6 \times 10^{-4} = \frac{(x)(x)}{0.342-x} \quad \text{assume small}$$

$$x = 0.015 \text{ M}$$

Check assumption

$$\frac{0.015}{0.342} \times 100 = 4.9\% < 5\% \quad \checkmark$$

Eg conc

$$[HF] = 0.342 - 0.015 = 0.327 \text{ M}$$

$$[H_3O^+] = 0.015 \text{ M}$$

$$[F^-] = 0.015 \text{ M}$$

$$[OH^-] = k_w = [H_3O^+][OH^-]$$

$$1.0 \times 10^{-14} = (0.015)(x)$$

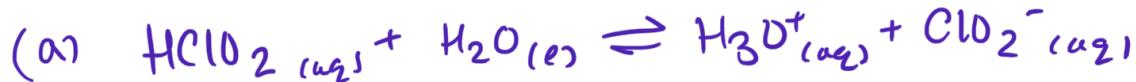
$$x = 6.67 \times 10^{-13} \text{ M}$$

(d) $pH = -\log(H_3O^+) = -\log(0.015) = 1.82$

$$pOH = -\log(OH^-) = -\log(6.67 \times 10^{-13}) = 12.18$$

Reaction 2: Consider a 0.342 M HClO₂ solution, the K_a of HClO₂ = 1.1 × 10⁻²

- (a) What is the chemical reaction?
- (b) What is the equilibrium expression?
- (c) What is the concentration of ClO₂⁻, H₃O⁺, OH⁻, and HClO₂ at equilibrium?
- (d) What is the pH and pOH of the solution?



(b) $K_a = \frac{[\text{H}_3\text{O}^+][\text{ClO}_2^-]}{[\text{HClO}_2]}$

	HClO ₂	H ₃ O ⁺	ClO ₂ ⁻
I	0.342	0	0
C	-x	+x	+x
E	0.342-x	x	x

$$1.1 \times 10^{-2} = \frac{(x)(x)}{0.342 - x}$$

can't assume small because K isn't super small.

$$0.003751 - 1.1 \times 10^{-2}x = x^2$$

$$x^2 + 1.1 \times 10^{-2}x - 0.003751 = 0$$

$$-1.1 \times 10^{-2} \pm \sqrt{(1.1 \times 10^{-2})^2 - 4(1)(-0.003751)} \over 2(1)$$

$$x = 0.05599$$

$$[\text{HClO}_2] = 0.342 - 0.05599 = 0.3364 \text{ M}$$

$$[\text{H}_3\text{O}^+] = 0.05599 \text{ M}$$

$$[\text{ClO}_2^-] = 0.05599 \text{ M}$$

$$[\text{OH}^-] = K_w = [\text{H}_3\text{O}^+][\text{OH}^-]$$

$$1.0 \times 10^{-14} = (0.05599)(x)$$

$$x = 1.78 \times 10^{-13}$$

(d) $\text{pH} = -\log(0.05599) = 1.25$

$$\text{pOH} = -\log(1.78 \times 10^{-13}) = 12.75$$

Reaction 3: Consider a 0.342 M CH_3NH_2 solution, the K_b of CH_3NH_2 is 5.25×10^{-4}

- What is the chemical reaction?
- What is the equilibrium expression?
- What is the concentration of CH_3NH_2 , H_3O^+ , OH^- , and CH_3NH_3^+ at equilibrium?
- What is the pH and pOH of the solution?



(b) $K_b = \frac{[\text{CH}_3\text{NH}_3^+][\text{OH}^-]}{[\text{CH}_3\text{NH}_2]}$

	CH_3NH_2	CH_3NH_3^+	OH^-
I	0.342	0	0
C	-x	+x	+x
E	$0.342 - x$	x	x

$$5.25 \times 10^{-4} = \frac{(x)(x)}{0.342 - x}$$

assume small
check assumption

$$x = 0.0137$$

$$\frac{0.0137}{0.342} \times 100 = 4\% \quad < 5\% \quad \checkmark$$

$$[\text{CH}_3\text{NH}_2] = 0.342 - 0.0137 = 0.3283 \text{ M}$$

$$[\text{CH}_3\text{NH}_3^+] = 0.0137 \text{ M}$$

$$[\text{OH}^-] = 0.0137 \text{ M}$$

$$[\text{H}_3\text{O}^+] = K_w = [\text{H}_3\text{O}^+][\text{OH}^-]$$

$$1.0 \times 10^{-14} = (x)(0.0137)$$

$$x = 7.299 \times 10^{-13} \text{ M}$$

(d) $\text{pH} = -\log(7.299 \times 10^{-13}) = 12.14$

$$\text{pOH} = -\log(0.0137) = 1.86$$

Now compare Reaction 1, 2, and 3. Which has the highest pH? Which has the lowest pH? Which is the strongest acid? Which is the strongest base?

	R2	R1	R3
pH	1.25	1.82	12.14
pOH	12.75	12.18	1.86

lowest pH lowest pOH

The initial conc are all equal so we can compare strength based on pH & pOH

R2 strongest acid \rightarrow lowest pH
 \nexists largest K_a

R3 strongest base \rightarrow lowest pOH
 \nexists produces OH^- in solution because it is a base