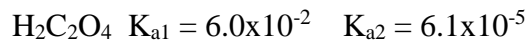
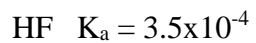
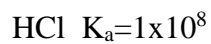
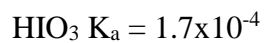
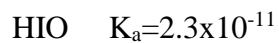
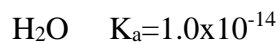
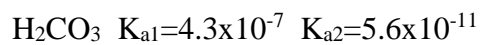
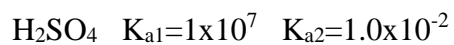
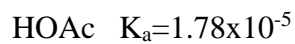


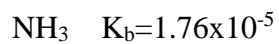
CHMG-142
"Recitation"

Name(s): _____

Dissociation constants of acids:



Dissociation constants of bases:



I mix together 50.0 mL of 0.100 M NaIO₃, 50.00 mL of 0.100 M NaOH, and 10.0 mL of 0.100 M HIO₃. What is the pH of the mixture?

Piece #1 What is HIO₃?

Acid

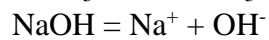
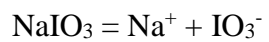
Piece #2 What is NaOH?

Base

Piece #3 What is NaIO₃?

Salt

Piece #4 Dissociate all of the salts into their ions.



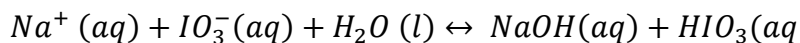
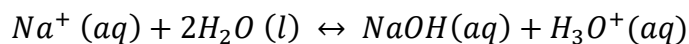
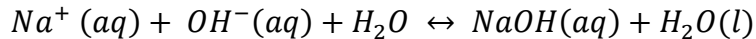
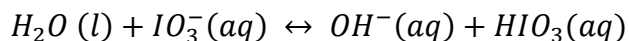
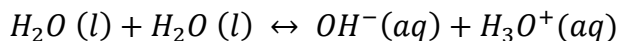
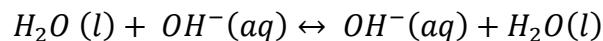
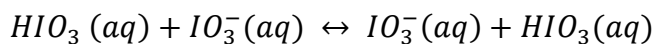
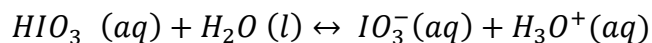
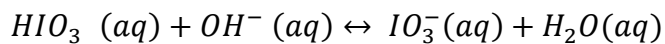
Piece #5 Make a list of all the acids.



Piece #6 Make a list of all the bases.



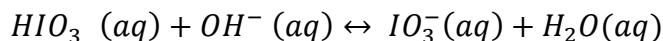
Major breakthrough #1. Write a balanced reaction for the reaction of EACH acid with EACH and every base.



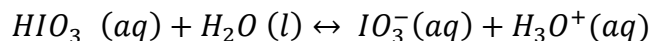
Really no perfect way to write the Na^+ equations. They borrow an H^+ from water by stealing the OH^- . In the end, they don't matter anyway because $NaOH$ is a strong base!

Major Breakthrough #2 For each reaction you wrote, determine the equilibrium constant (K) or the relative value of it (SFB, FB, etc.)

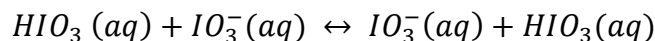
Strong base with weak acid: $K = \text{SF B}$



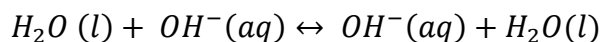
Weak acid in water, just a K_a . $K_a = 1.7 \times 10^{-4}$



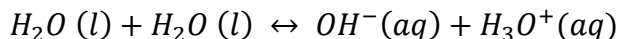
A weak acid with its conjugate base. Nothing happens. $K = 0$



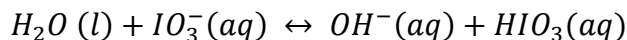
A strong base in water: $K_b = \text{FB}$



Water and water; $K_w = 1.0 \times 10^{-14}$



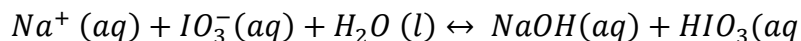
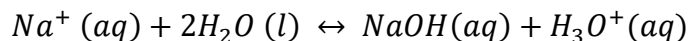
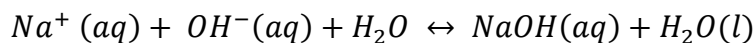
Water and the conjugate base of HIO_3 :



$$K_a K_b = K_w = 1.0 \times 10^{-14}$$

$$K_b = \frac{1.0 \times 10^{-14}}{1.7 \times 10^{-4}} = 5.88 \times 10^{-11}$$

All the sodium reactions involve an infinitely weak acid (Na^+) which is the conjugate acid of a strong base (NaOH). So, effectively $K = 0$



Finally, some math #1 Determine the DILUTED concentration of HIO_3 in the mixture before any acid/base reaction has occurred.

$$M_1V_1 = M_2V_2$$

$$0.100 \text{ M} \times 10.0 \text{ mL} = M_2(110.0 \text{ mL})$$

$$M_2 = 0.009091 \text{ M}$$

Finally, some math #2 Determine the DILUTED concentration of Na^+ in the mixture before any acid/base reaction has occurred.

$$M_1V_1 = M_2V_2$$

$$0.100 \text{ M} \times 50.0 \text{ mL} = M_2(110.0 \text{ mL})$$

$$M_2 = 0.04545 \text{ M}$$

Finally, some math #3 Determine the DILUTED concentration of IO_3^- in the mixture before any acid/base reaction has occurred.

$$M_1V_1 = M_2V_2$$

$$0.100 M \times 50.0 mL = M_2(110.0 mL)$$

$$M_2 = 0.04545 M$$

Finally, some math #4 Determine the DILUTED concentration of OH⁻ in the mixture before any acid/base reaction has occurred.

$$M_1V_1 = M_2V_2$$

$$0.100 M \times 50.0 mL = M_2(110.0 mL)$$

$$M_2 = 0.04545 M$$

Let's make a picture #1 For the reaction with the BIGGEST K, construct an ICE chart.

Biggest would be the SFB one!

| | $\text{HIO}_3 (\text{aq}) +$ | $\text{OH}^- (\text{aq})$ | \leftrightarrow | $\text{IO}_3^- (\text{aq}) +$ | $\text{H}_2\text{O} (\text{l})$ |
|---|------------------------------|---------------------------|-------------------|-------------------------------|---------------------------------|
| I | 0.009091 M | 0.04545 M | | 0.04545 | lots |
| C | -x | -x | | +x | +x |
| E | $0.009091 - x$ | $0.04545 - x$ | | $0.04545 + x$ | lots |

LET'S DO IT! #1 Solve the ICE chart for the reaction with the BIGGEST K.

| | $\text{HIO}_3 (\text{aq}) +$ | $\text{OH}^- (\text{aq})$ | \leftrightarrow | $\text{IO}_3^- (\text{aq}) +$ | $\text{H}_2\text{O} (\text{l})$ |
|---|------------------------------|---------------------------|-------------------|-------------------------------|---------------------------------|
| I | 0.009091 M | 0.04545 M | | 0.04545 | lots |
| C | -x | -x | | +x | +x |
| E | 0, limiting | $0.04545 - x$ | | $0.04545 + x$ | lots |

$$0.009091 - x = 0$$

$$x = 0.009091$$

| | $\text{HIO}_3 (\text{aq}) +$ | $\text{OH}^- (\text{aq})$ | \leftrightarrow | $\text{IO}_3^- (\text{aq}) +$ | $\text{H}_2\text{O} (\text{l})$ |
|---|------------------------------|---------------------------|-------------------|-------------------------------|---------------------------------|
| I | 0.009091 M | 0.04545 M | | 0.04545 | lots |
| C | -x | -0.009091 | | +0.009091 | +x |
| E | 0, limiting | 0.03636 | | 0.05454 | lots |

Let's make a picture #2 For the reaction with the second BIGGEST K, construct an ICE chart using the concentrations as they exist AFTER the first reaction is over.

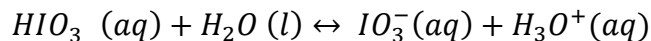
LET'S DO IT! #2 Solve the ICE chart for the reaction with the second BIGGEST K.

Next is just the FB one, but it doesn't really do anything

| | $\text{OH}^- (\text{aq}) +$ | $\text{H}_2\text{O} (\text{l})$ | \leftrightarrow | $\text{OH}^- (\text{aq}) +$ | $\text{H}_2\text{O} (\text{l})$ |
|---|-----------------------------|---------------------------------|-------------------|-----------------------------|---------------------------------|
| I | 0.03636 | LOTS | | 0 | 0 |
| C | -x | -x | | +x | +x |
| E | 0 | LOTS | | 0.03636 | x |

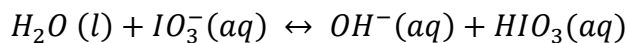
Repeat until the ICE charts stop yielding any significant change.

Next would be:



But I don't have any HIO₃ left, so I can't do it.

That leaves me with only one other meaningful reaction (K_w is insignificant here);



$$K_a K_b = K_w = 1.0 \times 10^{-14}$$

$$K_b = \frac{1.0 \times 10^{-14}}{1.7 \times 10^{-4}} = 5.88 \times 10^{-11}$$

| | IO ₃ ⁻ (aq) + | H ₂ O (l) | ↔ | HIO ₃ (aq) | + OH ⁻ (aq) |
|---|-------------------------------------|----------------------|---|-----------------------|------------------------|
| I | 0.05454 | | | 0.0 | 0.03636 |
| C | -x | -x | | +x | +x |
| E | 0.05454-x | | | x | 0.03636+x |

$$K_b = 5.88 \times 10^{-11} = \frac{(x)(0.03636 + x)}{0.05454 - x}$$

Assume $x \ll 0.0125$

$$5.88 \times 10^{-11} = \frac{(x)(0.03636 + x)}{0.05454 - x} \approx \frac{(x)(0.03636)}{(0.05454)}$$

$$x = 8.82 \times 10^{-11}$$

| | IO ₃ ⁻ (aq) + | H ₂ O (l) | ↔ | HIO ₃ (aq) | + OH ⁻ (aq) |
|---|-------------------------------------|-------------------------|---|-------------------------|-------------------------|
| I | 0.05454 | | | 0.0 | 0.03636 |
| C | -8.82×10^{-11} | -8.82×10^{-11} | | $+8.82 \times 10^{-11}$ | $+8.82 \times 10^{-11}$ |
| E | 0.05454 | | | 8.82×10^{-11} | 0.03636 |

DONE! DONE! DONE! #1

I mix together 50.0 mL of 0.100 M NaIO₃, 50.00 mL of 0.100 M NaOH, and 10.0 mL of 0.100 M HIO₃. What is the pH of the mixture?

$$pOH = -\log(0.03636) = 1.44$$

$$pH = 14 - pOH = 14 - 1.44 = 12.56$$