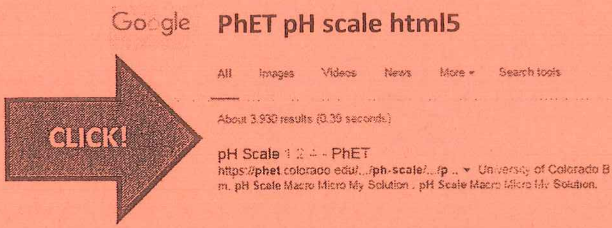
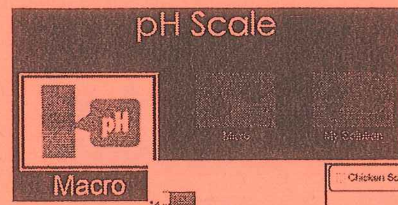
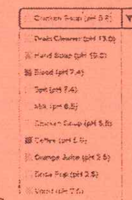
Name Beth "Key" Period __________

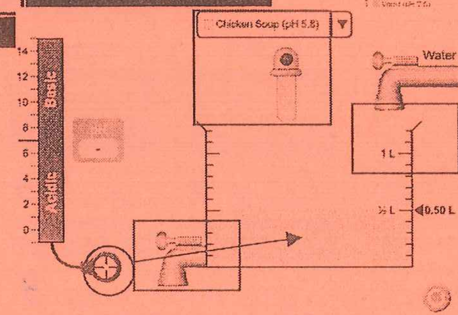
IB Chemistry 12







Setting up: The boxes in the picture, right, are pieces that move and affect the concentration and or amount of solution



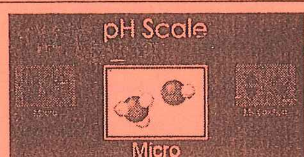
Move the concentration sensor into the solution (circle, arrow)

Review the controls. Try them out, see what they do. When done exploring them, click the reset button.

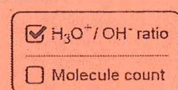
Part 1 Macro: Add some chicken soup to the beaker. How can you change the pH of the solution?

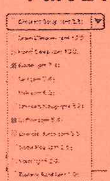
Diluting the solution with H_2O raises the pH.

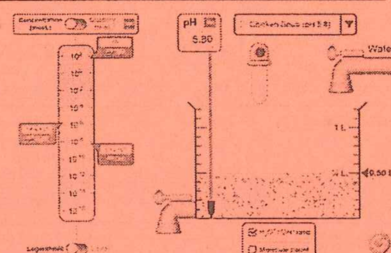
Part 2 Micro: Click



then check







← Choose the substance and fill in the table, below.

Substance	pH	Describe the dots	Concentration $[H_3O^+]$	Concentration $[OH^-]$	pOH (14 - pH)	Classify A – Acid B – Base N – Neutral
Battery Acid	1.00	**a. More red** b. Equal red and blue c. More blue	1.0×10^{-1} H_3O^+	1.0×10^{-13} OH^-	14 – 1 = 13	A
Vomit	2.00	**a. More red** b. Equal red and blue c. More blue	1.0×10^{-2}	1.0×10^{-12}	12.00	A
Soda	2.50	**a. More red** b. Equal red and blue c. More blue	3.2×10^{-3}	3.2×10^{-12}	11.50	A
Coffee	5.00	**a. More red** b. Equal red and blue c. More blue	1.0×10^{-5}	1.0×10^{-9}	9.00	A
Milk	6.50	**a. More red** b. Equal red and blue c. More blue	3.2×10^{-7}	3.2×10^{-8}	7.50	A
Water	7.00	a. More red **b. Equal red and blue** c. More blue	1.0×10^{-7}	1.0×10^{-7}	7.00	N
Spit	7.40	a. More red b. Equal red and blue **c. More blue**	4.0×10^{-8}	2.5×10^{-7}	6.60	B
Blood	7.40	a. More red b. Equal red and blue **c. More blue**	4.0×10^{-8}	2.5×10^{-7}	6.60	B
Soap	10.00	a. More red b. Equal red and blue **c. More blue**	1.0×10^{-10}	1.0×10^{-4}	4.00	B
Drain Cleaner	13.00	a. More red b. Equal red and blue **c. More blue**	1.0×10^{-13}	1.0×10^{-1}	1.00	B

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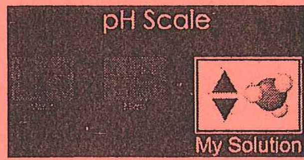
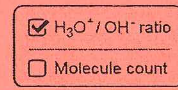
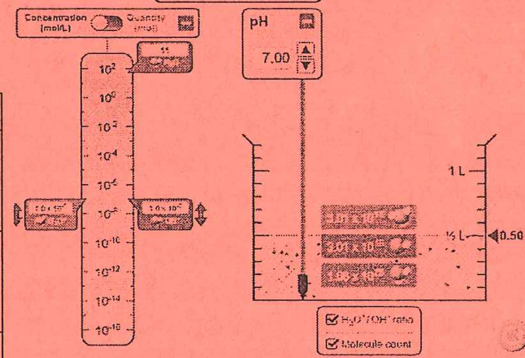
Part 3 pH Scale: Click  then check the box → 

Fill in table following example for pH7.



pH	$[H_3O^+]$	$[^-OH]$	Red/blue?	ABN
pH 7.00	1.0×10^{-7} H_3O^+	1.0×10^{-7} OH^-	equal	Neutral
pH 9.00	1.0×10^{-9}	1.0×10^{-5}	Blue	Base
pH 11.00	1×10^{-11}	1×10^{-3}	Blue	B
pH 13.00	1×10^{-13}	1×10^{-1}	Blue	B
pH 5.00	1×10^{-5}	1×10^{-9}	Red	Acid
pH 3.00	1×10^{-3}	1×10^{-11}	Red	A
pH 1.00	1×10^{-1}	1×10^{-13}	Red	A

Post lab Questions:

In part 2, what relationship is there between pH and the dot color?

the lower the pH the more red dots, the higher the more blue.

In part 2, what relationship is there between pH and the pOH?

$pH + pOH = 14$

In parts 2+3, what relationship is there between $[H_3O^+]$ and $[^-OH]$ (the sliders)?

$[H_3O^+][OH^-] = 1 \times 10^{-14}$

In part 3, what relationship is there between pH and $[H_3O^+]$ (there is a cool numerical relationship!)?

$pH = -\log[H_3O^+]$

Going further

Using the data in part 3, predict what goes in the boxes:

pH	H_3O^+	OH^-
pH 8.00	1×10^{-8}	1×10^{-6}
pH 4.00	1×10^{-4}	1×10^{-10}

Using the data from part 2, what would you predict the pOH's to be for these entries in table 3?

pH	H_3O^+	OH^-	pOH
pH 2.00			12
pH 10.00			4
pH 6.00			8
pH 12.00			2

Procedure:

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Go back to the "Micro Tab" and add battery acid, then use the bottom faucet to drain the tank until 0.1 L remains.

1) Record the pH of the solution: 1.00

2) How many moles of H_3O^+ (hydronium) ions are present in each liter of the solution?
***Answer in scientific notation and decimal form.
Recall how pH relates to the exponent of the concentration of H_3O^+ ions.

1×10^{-1} mol H_3O^+

3) How many moles of H_3O^+ ions are present in 0.1 L of the solution (the volume in the cup)?

$M = \frac{mol}{L}$ $\quad \left(1 \times 10^{-1} \frac{mol}{L}\right)(0.1 L) = .01$ mol H_3O^+

Add water to the 0.1L of battery acid until there is 1 L of solution in the container. *Compared to the H_3O^+ in the battery acid, the H_3O^+ in the water is negligible.* So, we can consider the amount of H_3O^+ in the diluted solution to be unchanged by the added water.

4) Since the amount of hydronium is essentially unchanged, how many moles of H_3O^+ ions are present in the liter of diluted solution?

.01 mol H_3O^+

5) What is the new concentration of H_3O^+ ions, in moles per liter?

$\frac{.01 mol}{1.00 L}$ or 1.0×10^{-2} M

6) What is the pH of the new diluted solution?

2.0

7) Explain why diluting the battery acid increased the pH by 1.

The # ions (H^+) decreased by a factor of 10.

Drain the 10% battery acid solution until 0.1 L remains. Be careful not to drain too much of the solution. If you drain too much, you will have to restart the experiment from the beginning. Pour water into the container until the volume again reaches 1 liter. Be careful not to pour too much water into the solution.

8) After again increasing the volume by a factor of 10, what is the new concentration of H_3O^+ ions?

1.0×10^{-3} M

9) What is the pH of the new solution?

3.0

Drain the 1% battery acid solution until 0.1 L remains. Pour water into the container until the volume again reaches 1 liter.

10) After again increasing the volume by a factor of 10, what is the new concentration of H_3O^+ ions?

1.0×10^{-4} M

11) What is the pH of the new solution?

4.0

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Drain the 0.1% battery acid solution until 0.1 L remains. Pour water into the container until the volume again reaches 1 liter.

12) After again increasing the volume by a factor of 10, what is the new concentration of H_3O^+ ions?

$1.0 \times 10^{-5} M$

13) What is the pH of the new solution?

~5

Drain the 0.01% battery acid solution until 0.1 L remains. Pour water into the container until the volume again reaches 1 liter.

14) After again increasing the volume by a factor of 10, what is the new concentration of H_3O^+ ions?

$1.0 \times 10^{-4} M$

15) What is the pH of the new solution?

~6

Drain the 0.001% battery acid solution until 0.1 L remains. Pour water into the container until the volume again reaches 1 liter.

16) After again increasing the volume by a factor of 10, what is the new concentration of H_3O^+ ions?

~2.0×10^{-7}

17) What is the pH of the new solution?

~6.8

18) Why did the pH increase by a lesser amount than previous dilutions? *Is the italicized statement in step F still true? What happens to the difference between the solution's H_3O^+ ion concentration and water's H_3O^+ ion concentration each time you dilute the solution?*

The autoionization of H_2O.

$$H_2O + H_2O \leftrightarrow H_3O^+_{(aq)} + OH^-_{(aq)}$$

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

Q. Use the *Custom* tab at the bottom to answer the following questions. Manipulate the amount of hydronium and hydroxide in the custom solution.

19) As the H_3O^+ ion concentration decreases, the pH ___increases___.

20) The product of a solution's H_3O^+ concentration and its OH^- concentration must always be 1×10^{-14}. So, if a solution's H_3O^+ concentration goes down, the solution's OH^- concentration must go ___up___. In other words, if we have **less hydronium**, we must have ___more___ **hydroxide**.