Names: _____

Acids – Bases: pH

Lab & Worksheet

Simulations: *https://phet.colorado.edu/sims/html/ph-scale/latest/ph-scale_en.html*
On-line questions & submission form: *http://chemconnections.org/general/chem108/Acids-Bases%20Guide.html*
Reference & Tutorial: https://groups.chem.ubc.ca/courseware/pH/index.html

Characterization of acids and bases by taste is obviously risky and is not a sound experimental approach. A better method is to use acid–base indicators, which change color based on the acidity or basicity of a solution. The earliest known acid–base indicators were plant extracts of violets or lilacs. These indicators were later absorbed onto paper and dried to yield indicator papers. Among the most common of modern indicator papers are red and blue litmus paper. Red litmus turns blue in basic solution and blue litmus turns red in acidic solution.

Improving upon the capabilities of litmus paper, *Hydrion*™ pH paper, universal indicator, and various types of pH meters are able to quantitatively measure the pH/acidity/basicity of various solutions. The following table includes acids, bases, and neutral solutions of some common substances. Red and blue litmus paper, pH paper and universal indicator will be used to test each solution.

Organize into a group of 3 or 4. You will record your observations for litmus, then infer and record a pH value from the respective observed colors of pH paper, and each solution after adding a few drops of universal indicator. Those pH values will be compared to a set of pH data that was obtained using a pH meter. Data is provided on-line. SEE:
http://chemconnections.org/general/chem108/Acids and Bases-Lab & WKS-pH meter data.pdf

Finally complete the last column entering acid, base or neutral for each solution in the *Description* column. Data for milk and biological samples, (saliva, blood, & vomit), N thru Q, have been provided except for the last 2 columns.

Observe Dr. R's demo, which has the data entered on the handout for A, B, and C. You will repeat the demonstration tests, for D through M, entering your observations and data in the following table. *Assume solutions are ~ 0.1 M.*

		Red Litmus	*Blue Litmus*	Solution pH		*pH Meter*	*Description*
				pH Paper	*Indicator*		
A	$HCl(aq)$ [stomach acid]	*red*	*red*	*1*	*2*	*1.0*	*acid*
B	$NaOH(aq)$ [drain cleaner]	*blue*	*blue*	*13*	*14*	*13.0*	*base*
C	$H_2O(l)$ [deionized water]	*red*	*blue*	*7*	*7*	*7.0*	*Neutral* (H_2O *is BOTH: acid & base)*
D	$H_2O(l) + CO_2(aq)$ [carbonated water] (Seltzer)					*6.4*	
E	$Na_2CO_3(aq)$ [sodium carbonate]					*10.1*	
F	$CH_3COOH(aq)$ [acetic acid] (vinegar)					*4.7*	
G	$CH_3COO^-, Na^+(aq)$ [sodium acetate]					*8.4*	

H	$NH_3(aq)$ [ammonia] (cleaner)					12.0	
I	$NH_4Cl(aq)$ [ammonium chloride]					6.1	
J	NaCl(aq) [sodium chloride]					7.0	
K	NaOCl(aq) [sodium hypochlorite] (bleach)					10.9	
L	$Mg(OH)_2$ Milk of Magnesia					12.2	
M	Lemon juice					3.8	
N	Milk	red	red	6	7	6.4	
O	Saliva (spit) and blood	blue	blue	7	7	7.3	
P	Vomit	red	red	1	2	1.9	
Q	Buffer (pH 7)	red	blue	7	7	7.0	

1. Rank the acids by its letter in the list from the strongest to the weakest using the pH meter data.

2. Rank the bases by its letter in the list from the strongest to the weakest using the pH meter data.

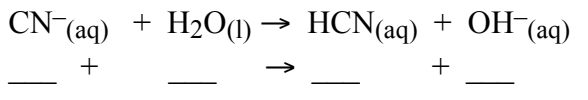
3. Define a buffer:

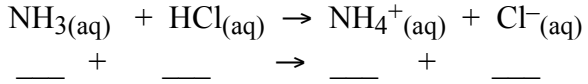
The pH of a healthy meat eater's urine is lower than the urine of healthy people eating a vegan diet. What this means is not fully understood, but some research has related the difference to a person's age, their relative amount of muscle, and the type of dietary protein they consume.

SEE: *https://www.medicalnewstoday.com/articles/323957.php#normal-ph-level*

4. What is the pH range for human urine, including all types of diets? _____

5. For each of the four reactions, classify the reactants as an acid (A) or a base (B) and the products as the conjugate acid (CA) or conjugate base (CB).





$H_2O_{(l)} + HCl_{(aq)} \rightarrow H_3O^+_{(aq)} + Cl^-_{(aq)}$

___ + ___ → ___ + ___

$CH_3COOH_{(aq)} + OH^-_{(aq)} \rightarrow CH_3COO^-_{(aq)} + H_2O_{(l)}$

___ + ___ → ___ + ___

6. Are the anions (conjugate bases) of strong acids: basic, neutral or acidic? (circle one)

7. Are the anions (conjugate bases) of weak acids: basic, neutral or acidic? (circle one)

8. Are the cations (conjugate acids) of weak bases: basic, neutral or acidic? (circle one)

9. Determine the pH for each of the following $[H^+]$:

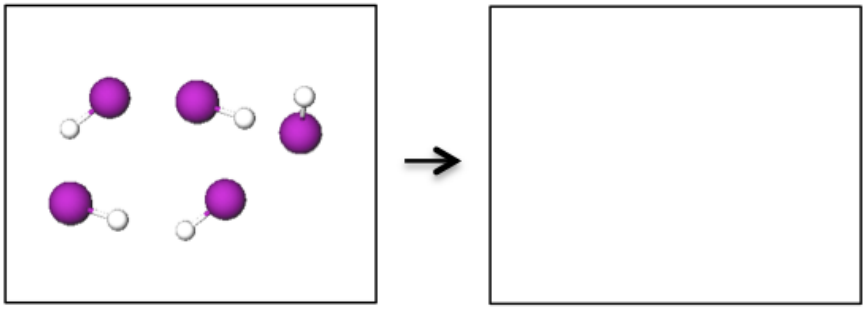
Molarity (M)	0.010	1.0×10^{-3}	0.00010	1×10^{-7}	0.0000001	1.0×10^{-9}	1×10^{-12}
pH							

10. Calculate $[H^+]$, $[OH^-]$, and pOH for each of the following pH values:

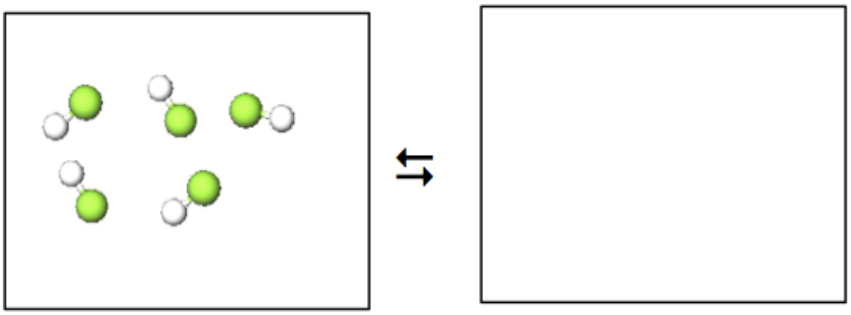
pH	2	5	7	9	12
$[H^+]$					
$[OH^-]$					
pOH					

11. *Model a strong and a weak acid solution.* The images on the left are the un-ionized acids. Draw the respective ionized forms to the right.

Hydroiodic acid, HI, a strong acid:



Hydrofluoric acid, HF, a weak acid, that is 40% ionized:



Refer to the following simulations link:
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Answer and submit the accompanying on-line questions:
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