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. The following table includes acids, bases, and neutral solutions of some common substances. Using red and blue litmus paper test each solution. Record your observations and complete the last column. Data for biological samples, (saliva, blood, & vomit) has been provided.

Improving upon the capabilities of litmus paper, universal indicator, *Hydrion*™ pH paper and various types of pH meters are able to quantitatively measure the pH/acidity/basicity of various solutions. In addition to the litmus paper, test the samples in the table with pH paper and then with a few drops of universal indicator; record the respective pH in the table. Stomach acid, drain cleaner and a buffer are given as examples, and data is provided for spit, vomit and the buffer.

Organize into a group of 3 or 4. Complete the following table. Assume solutions are ~ 0.1 M. Under the *Description* column choose: acid, base or neutral.

		Red Litmus	*Blue Litmus*	Solution pH		*Description*
				pH Paper	*Indicator*	
A	$HCl(aq)$ stomach acid	*red*	*red*	*1*	*2*	*acid*
B	$NaOH(aq)$ drain cleaner	*blue*	*blue*	*11*	*10*	*base*
C	$H_2O(l)$ deionized water					
D	$H_2O(l) + CO_2(aq)$ carbonated water (Seltzer)					
E	$Na_2CO_3(aq)$ baking soda					
F	$NaOCl(aq)$ bleach					
G	$CH_3COOH(aq)$ vinegar					
H	$NaCl(aq)$ salt solution					
I	$CH_3COO^-, Na^+(aq)$ salt solution					

J	$NH_4Cl(aq)$ ammonium chloride					
K	$NH_3(aq)$ ammonia (household cleaner)					
L	$Mg(OH)_2$ Milk of Magnesia					
M	Orange juice					
N	Milk					
O	Saliva (spit) and blood	blue	blue	7.4		
P	Vomit	red	red	2.0		
Q	Buffer (pH 7)	red	blue	7.0		*Neutral (BOTH: acid & base)*

1. Rank the acids by its letter in the list from the strongest to the weakest.

2. Rank the bases by its letter in the list from the strongest to the weakest.

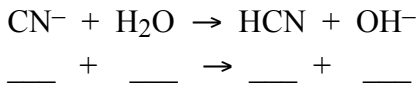
3. Define a buffer:

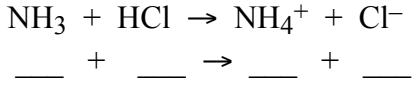
The pH of a meat eater's urine is lower than the urine of people eating a vegan diet. What this means is not fully understood, but some research has related the difference to a person's age, their relative amount of muscle, and the type of dietary protein they consume.

SEE: *https://www.youtube.com/watch?v=wj0FNMlXMpU*
Start the video @ 3:27 to see how red cabbage can be used to test the pH of urine.

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).





$H_2O + HCl \rightarrow H_3O^+ + Cl^-$

___ + ___ → ___ + ___

$CH_3COOH + OH^- \rightarrow CH_3COO^- + H_2O$

___ + ___ → ___ + ___

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

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

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

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

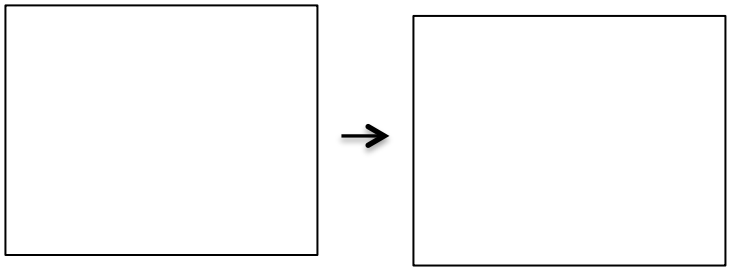
Molarity (M)	0.010	1.0×10^{-3}	0.00010	1×10^{-7}	0.0000001	1.0×10^{-9}	1×10^{-12}
pH							

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

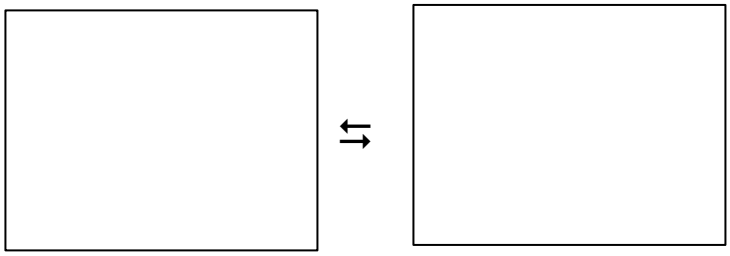
pH	2	5	7	9	12
$[H^+]$					
$[OH^-]$					
pOH					

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:



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Answer and submit the accompanying on-line questions:
http://chemconnections.org/general/chem108/Acids-Bases%20Guide.html