Chem 108: Class/ Lab

Week 13

Pick a vial and a plastic dropper

Using the vial number, sign-in on the Lab roster

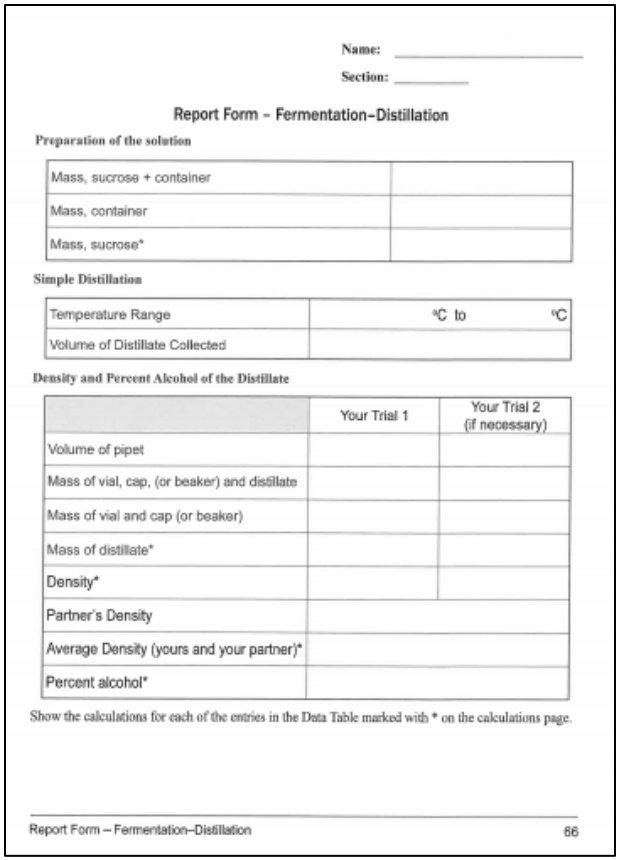
Pick up HANDOUTS

1) Fluid Exchange Form & Post Lab (Handout)
2) Acid-Bases: pH (Handout)

Fermentation / Distillation
Report pp. 66-67 + POST LAB Questions

Due Today

http://chemconnections.org/general/chem120/ethanol-ques-108.htm



Name: _____

Section: _____

Report Form – Fermentation–Distillation

Preparation of the solution

Mass, sucrose + container	
Mass, container	
Mass, sucrose*	

Simple Distillation

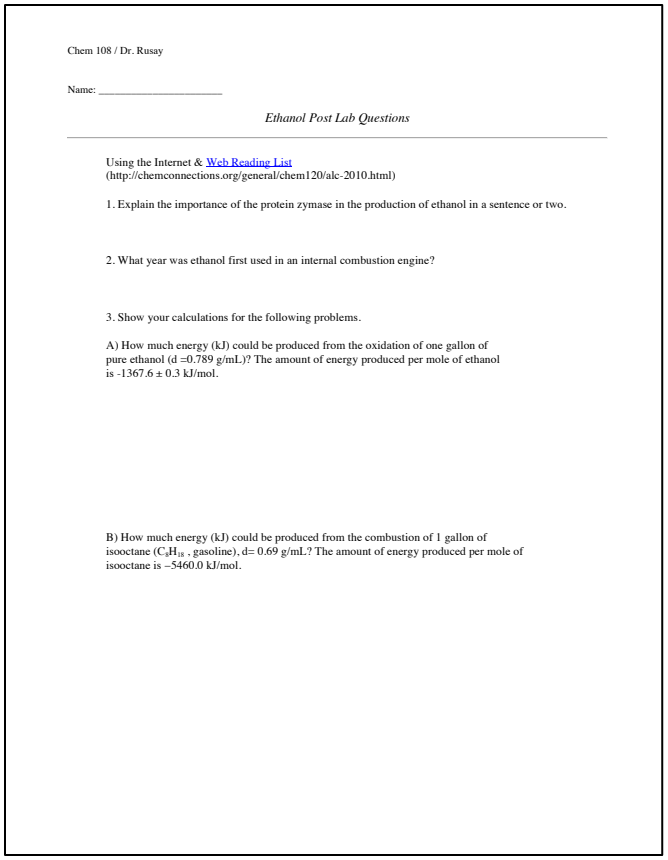
Temperature Range	°C to	°C
Volume of Distillate Collected		

Density and Percent Alcohol of the Distillate

	Your Trial 1	Your Trial 2 (if necessary)
Volume of pipet		
Mass of vial, cap, (or beaker) and distillate		
Mass of vial and cap (or beaker)		
Mass of distillate*		
Density*		
Partner's Density		
Average Density (yours and your partner)*		
Percent alcohol*		

Show the calculations for each of the entries in the Data Table marked with * on the calculations page.

Report Form – Fermentation–Distillation 66



Chem 108 / Dr. Rusay

Name: _____

Ethanol Post Lab Questions

Using the Internet & Web Reading List
(http://chemconnections.org/general/chem120/alc-2010.html)

1. Explain the importance of the protein zymase in the production of ethanol in a sentence or two.

2. What year was ethanol first used in an internal combustion engine?

3. Show your calculations for the following problems.

A) How much energy (kJ) could be produced from the oxidation of one gallon of pure ethanol (d =0.789 g/mL)? The amount of energy produced per mole of ethanol is -1367.6 ± 0.3 kJ/mol.

B) How much energy (kJ) could be produced from the combustion of 1 gallon of isooctane (C_8H_{18} , gasoline), d= 0.69 g/mL? The amount of energy produced per mole of isooctane is –5460.0 kJ/mol.

Chem 108: Class/ Lab

Week 13: 2019s

Do Today:

1) Fluid Exchange (Handout)

Due Next Lab

2) Acid-Base: pH (Handout)

Data completed & signed before leaving Lab

Follow Instructions

http://chemconnections.org/general/chem120/fluid-ex.108.html

Chem 108: Class/ Lab

Week 13

TODAY:

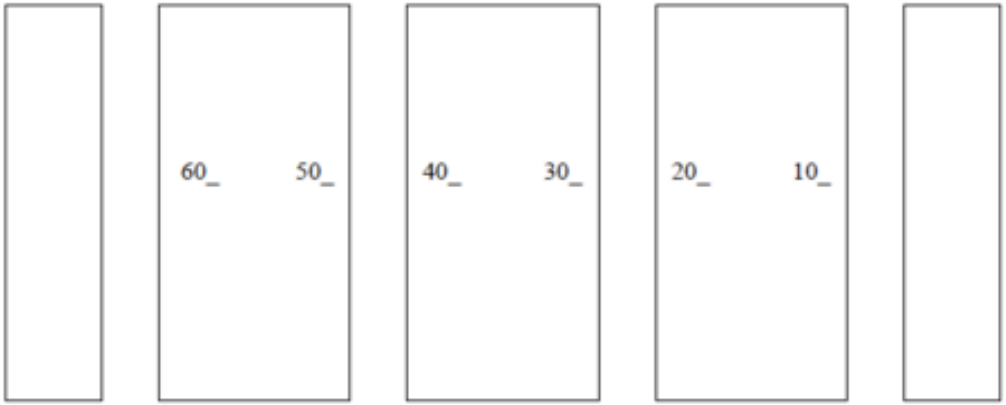
Fluid Exchange (Handout)

3) You have been assigned a geographical location for your Global Residence. Check the ***Global Homelands Map,*** which follows, for your location and if necessary move to your place of residence.

http://chemconnections.org/general/chem120/fluid-ex.108.html

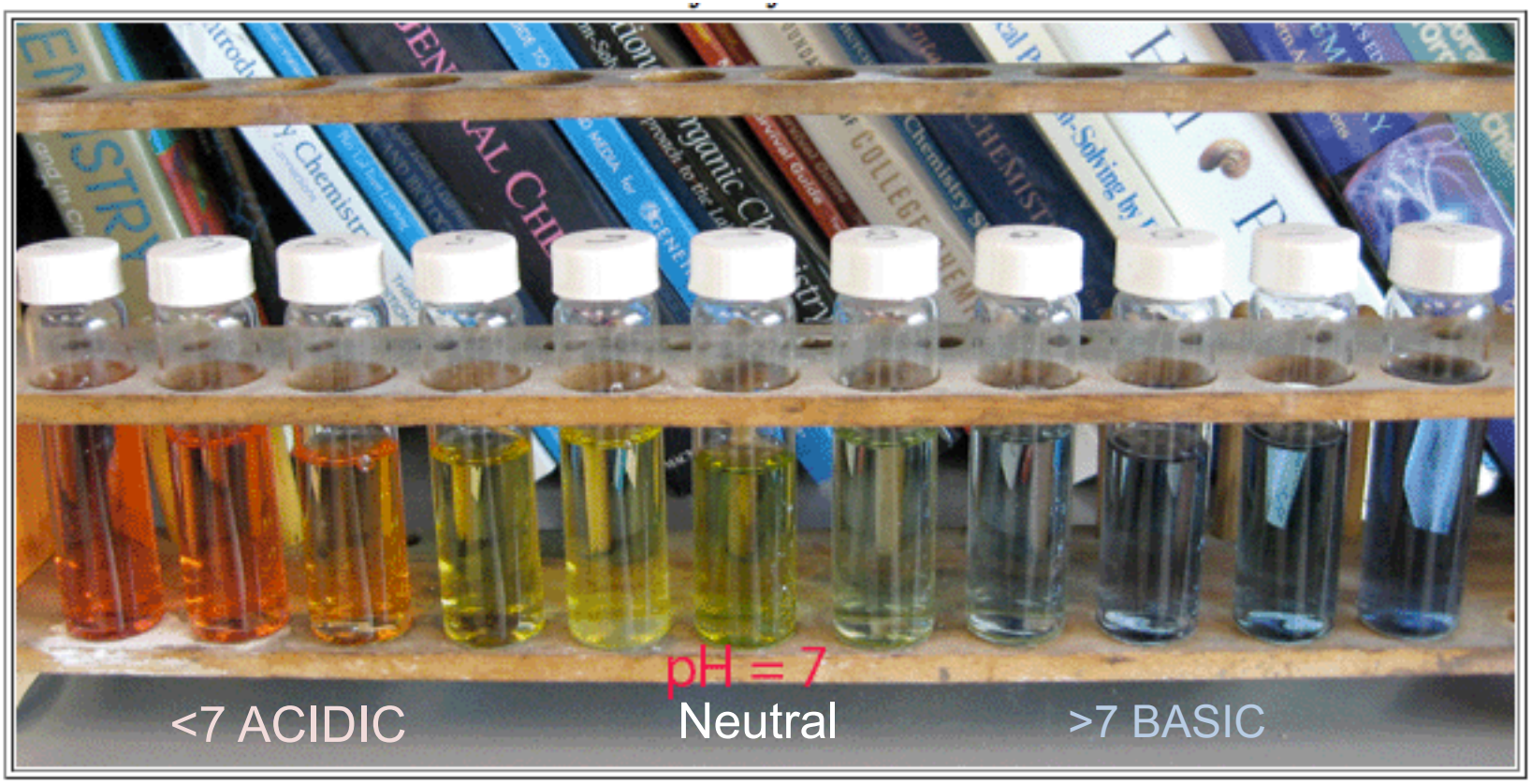
Global Homelands Map

(Front of Lab)



Wait for Dr. R's instructions on exchanging fluids, keeping records, and using the handout provided.

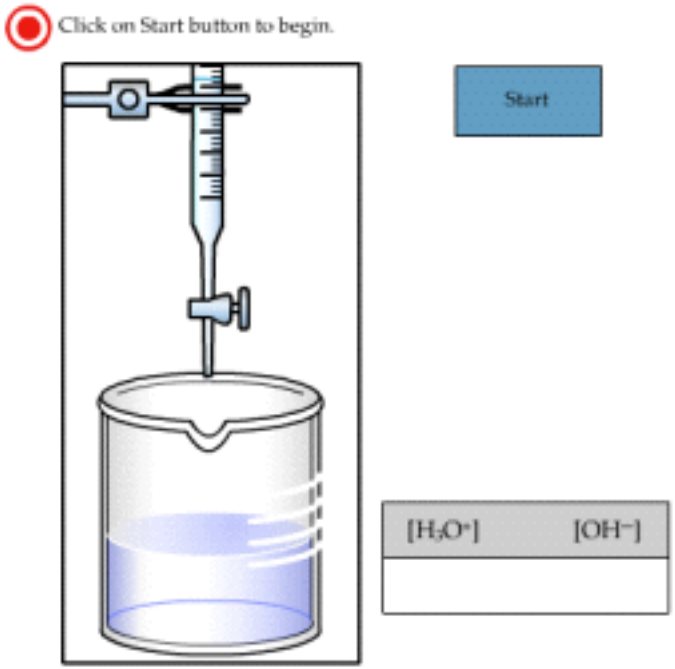
Acid-Base Indicators



Water as an Acid and a Base

Self-ionization

$$H_2O(l) + H_2O(l) \rightleftharpoons H_3O^+(aq) + OH^-(aq)$$



http://chemconnections.org/general/movies/KwActivity.swf

Pure Water is an Acid and a Base

It is amphoteric. (It can behave either as an acid or a base).

$$\mathbf{H_2O}(l) + \mathbf{H_2O}(l) \rightleftharpoons \mathbf{H_3O^+}(aq) + \mathbf{OH^-}(aq)$$

$$H_2O + H_2O \leftrightarrows H_3O^+ + OH^-$$

acid 1 base 2 conj acid 2 conj base 1

$$K = \frac{[H_3O^+][OH^-]}{[\cancel{H_2O}]\,[\cancel{H_2O}]}$$

- $K_w = 1 \times 10^{-14}$ at 25°C
- $K_w = [H_3O^+][OH^-] = [1 \times 10^{-7}M][1 \times 10^{-7}M]$

NOTE: ***only concentrations [mol/L] are used in the calculation****;*
liquids (l) and solids (s) are not included

https://phet.colorado.edu/en/simulation/ph-scale-basics

The pH Scale

pH: the negative logarithm of the hydrogen ion concentration.

Beer's pH ~ 4

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

0	10^{0}	1
1	10^{-1}	0.1
2	10^{-2}	0.01
3	10^{-3}	0.001
4	10^{-4}	0.0001
5	10^{-5}	0.00001
6	10^{-6}	0.000001
7	10^{-7}	0.0000001
8	10^{-8}	0.00000001
9	10^{-9}	0.000000001
10	10^{-10}	0.0000000001
11	10^{-11}	0.00000000001
12	10^{-12}	0.000000000001
13	10^{-13}	0.0000000000001
14	10^{-14}	0.00000000000001

Quantitative, logarithmic, numeric scale based on testing the electric current of aqueous solutions & relating it to the equilibrium concentration of the hydrogen ion, $[H^+_{(aq)}] = [H_3O^+_{(aq)}]$

Introduced in 1909 by Søren Sørensen, Danish brewer/chemist, as a convenient way of expressing acidity……. Providing much improved quality control in brewing.

http://www.chemconnections.org/general/chem108/Acids-Bases%20Guide.html

The pH Scale

- $pH \approx -\log[H^+] \approx -\log[H_3O^+]$

- pH in water ranges from 0 to 14.

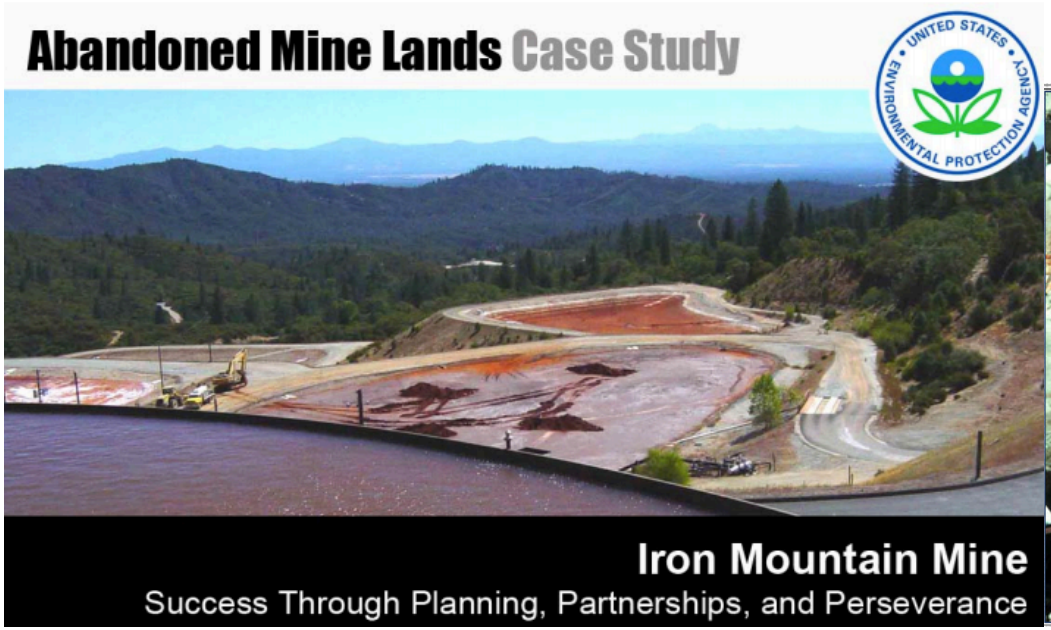
  $K_w = 1.00 \times 10^{-14} = [H^+]\,[OH^-]$

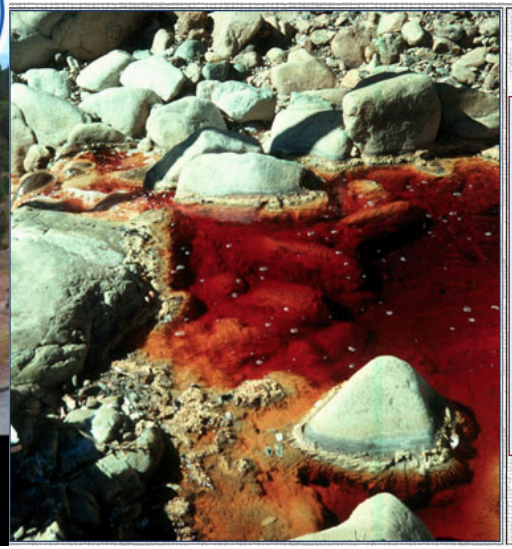
  $pK_w = 14.00 = pH + pOH$

- As pH rises, pOH falls (sum = 14.00).
- There are no theoretical limits on the values of pH or pOH. (e.g. pH of 2.0 M HCl is -0.301)

https://phet.colorado.edu/en/simulation/ph-scale-basics

The pH Scale



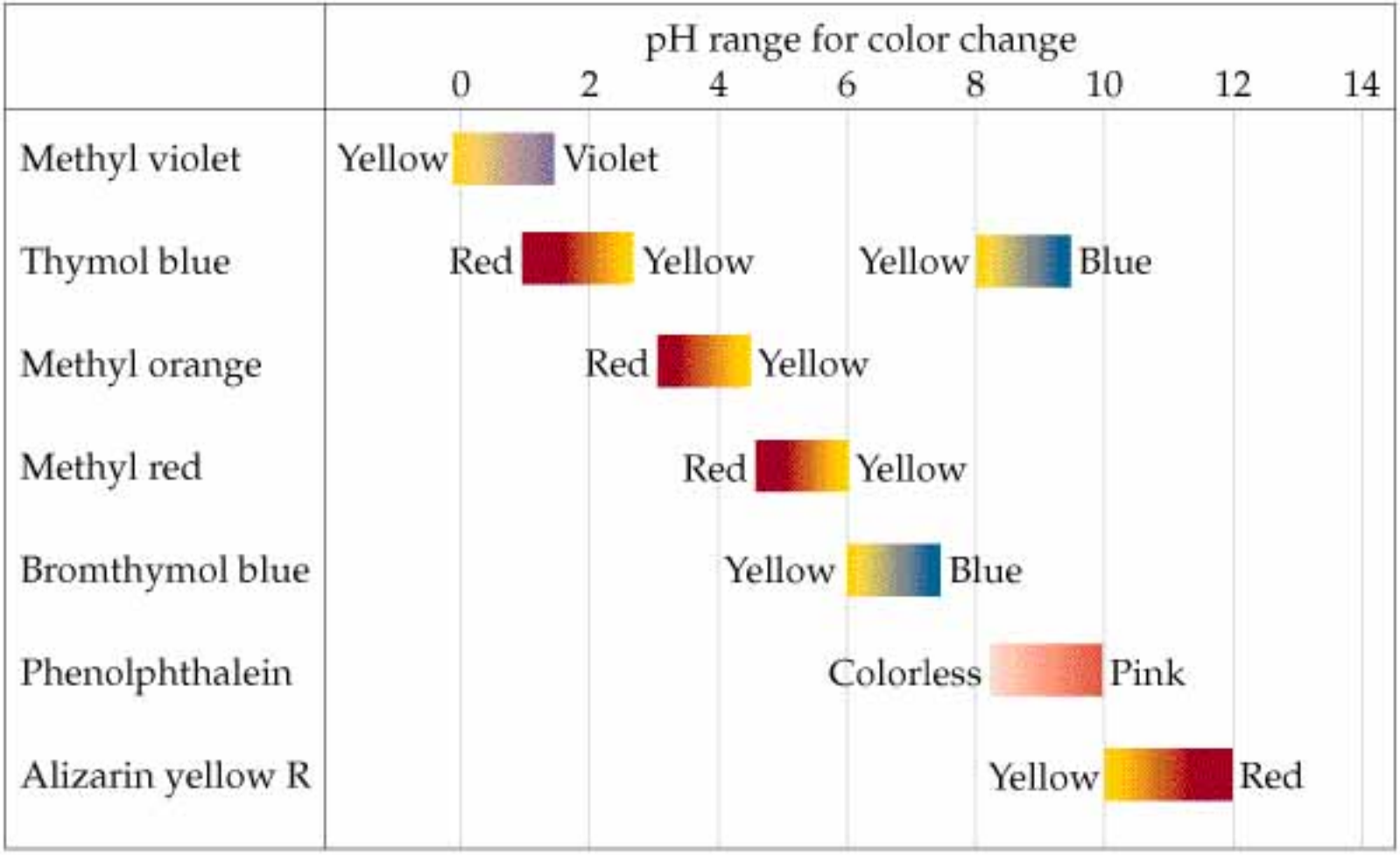


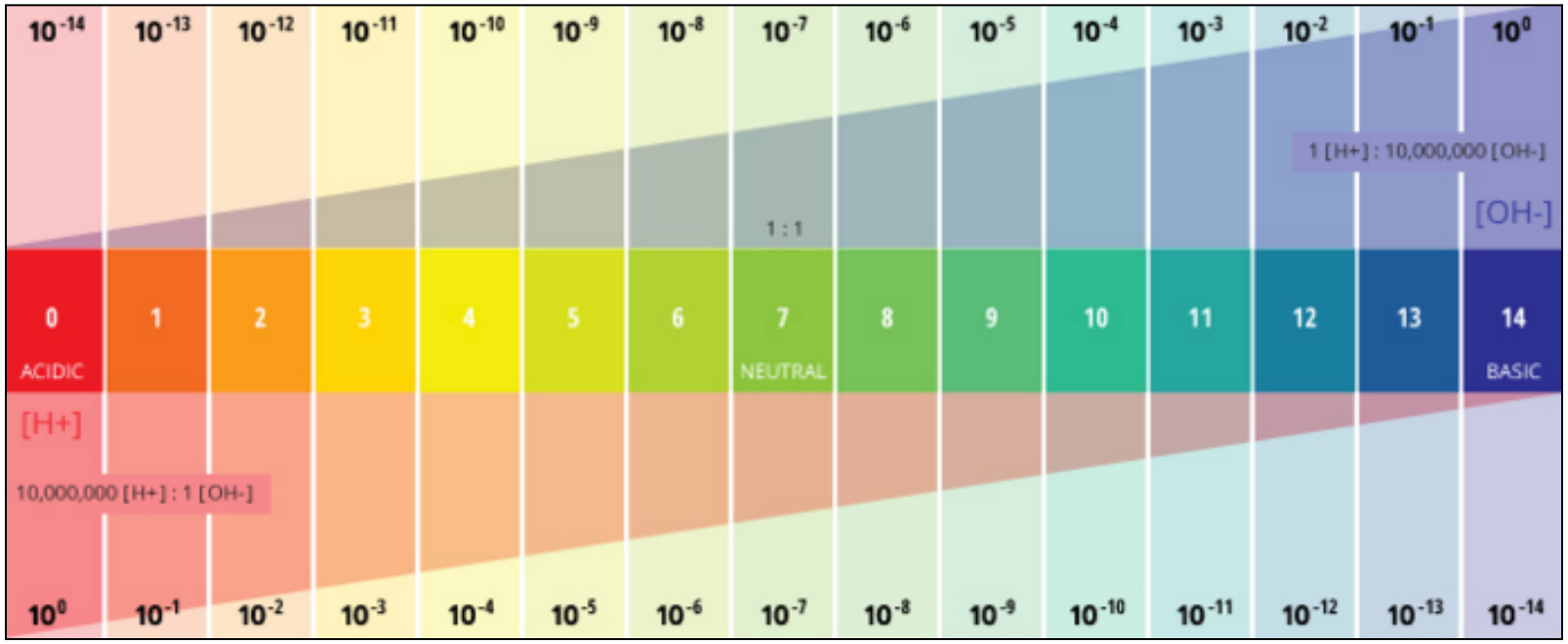
The drainage water from the Iron Mountain Mine is the most acidic water on Earth; some samples collected in 1990 and 1991 have been measured to have a pH value of -3.6, which is the lowest pH observed globally in a natural environment.

Indicators

Natural Indicators

Acid-Base Indicators



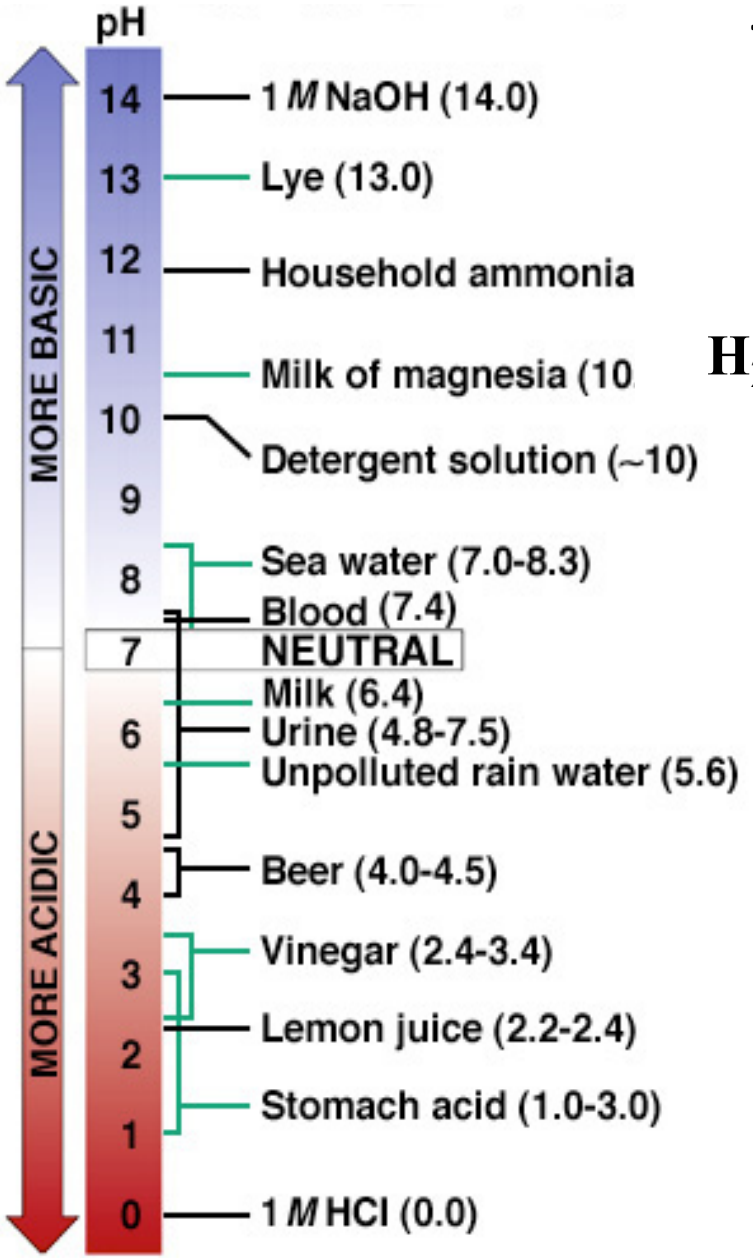


$$pH = -\log[H+] \quad = -\log [H_3O^+]$$

0	10^0	1
1	10^{-1}	0.1
2	10^{-2}	0.01
3	10^{-3}	0.001
4	10^{-4}	0.0001
5	10^{-5}	0.00001
6	10^{-6}	0.000001
7	10^{-7}	0.0000001
8	10^{-8}	0.00000001
9	10^{-9}	0.000000001
10	10^{-10}	0.0000000001
11	10^{-11}	0.00000000001
12	10^{-12}	0.000000000001
13	10^{-13}	0.0000000000001
14	10^{-14}	0.00000000000001

The Relations Among $[H_3O^+]$, pH, $[OH^-]$, and pOH

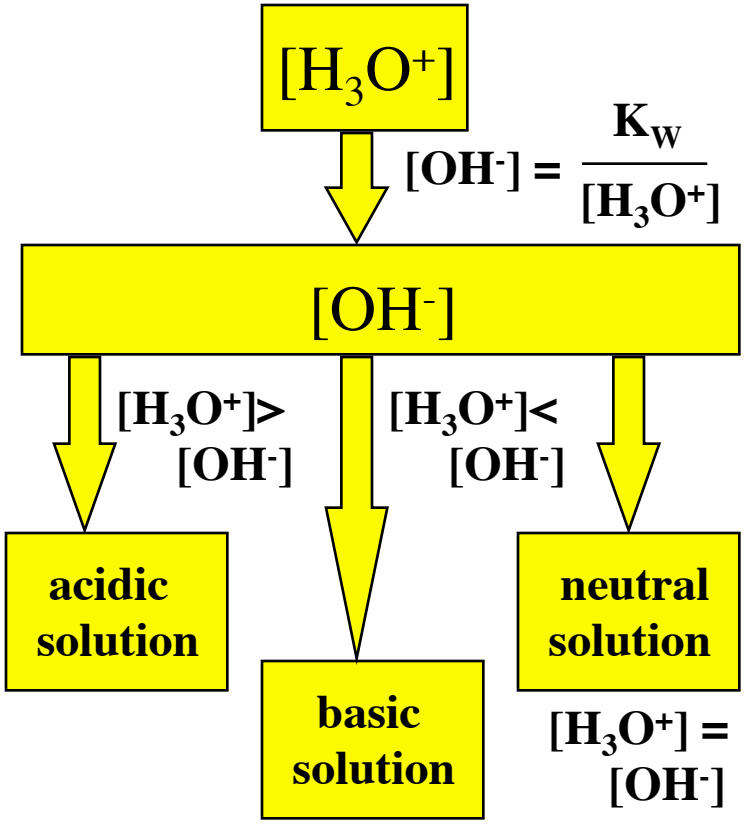
	$[H_3O^+]$	pH	$[OH^-]$	pOH
BASIC	1.0×10^{-15}	15.00	1.0×10^{1}	–1.00
	1.0×10^{-14}	14.00	1.0×10^{0}	0.00
	1.0×10^{-13}	13.00	1.0×10^{-1}	1.00
	1.0×10^{-12}	12.00	1.0×10^{-2}	2.00
	1.0×10^{-11}	11.00	1.0×10^{-3}	3.00
	1.0×10^{-10}	10.00	1.0×10^{-4}	4.00
	1.0×10^{-9}	9.00	1.0×10^{-5}	5.00
	1.0×10^{-8}	8.00	1.0×10^{-6}	6.00
NEUTRAL	1.0×10^{-7}	7.00	1.0×10^{-7}	7.00
ACIDIC	1.0×10^{-6}	6.00	1.0×10^{-8}	8.00
	1.0×10^{-5}	5.00	1.0×10^{-9}	9.00
	1.0×10^{-4}	4.00	1.0×10^{-10}	10.00
	1.0×10^{-3}	3.00	1.0×10^{-11}	11.00
	1.0×10^{-2}	2.00	1.0×10^{-12}	12.00
	1.0×10^{-1}	1.00	1.0×10^{-13}	13.00
	1.0×10^{0}	0.00	1.0×10^{-14}	14.00
	1.0×10^{1}	–1.00	1.0×10^{-15}	15.00



Th pH Values of Some Familiar Aqueous Solutions

(TODAY'S LAB EXPERIMENT)

$$H_2O(l) + H_2O(l) \rightleftharpoons H_3O^+(aq) + OH^-(aq)$$



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Week 13

1) Fluid Exchange
(Handout) *Due Next Lab*

TODAY:
2) Acid-Base: pH (Handout)
Data table completed & signed before leaving Lab

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http://chemconnections.org/general/chem108/Acids-Bases%20Guide.html

Acid-Base Strengths

pH [indicator paper & pH meter]

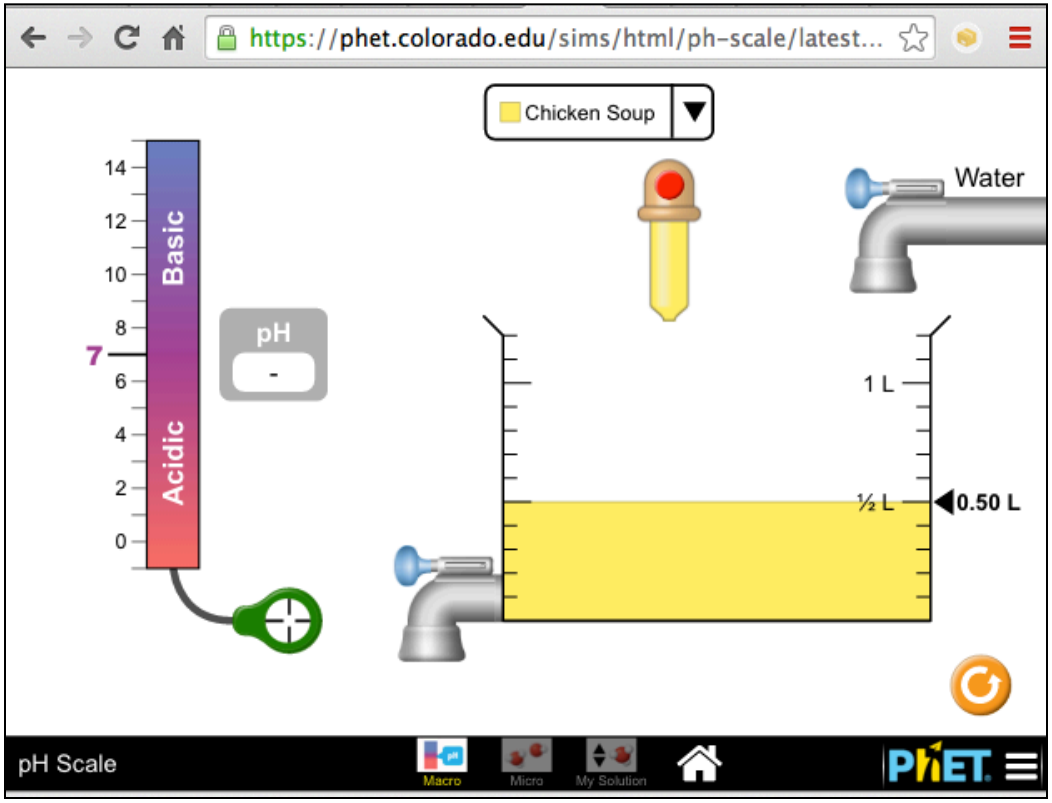
https://phet.colorado.edu/en/simulation/ph-scale

Strong Acid:

Strong Base:

Weak Acid:

Weak Base:



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

0	10^{0}	1
1	10^{-1}	0.1
2	10^{-2}	0.01
3	10^{-3}	0.001
4	10^{-4}	0.0001
5	10^{-5}	0.00001
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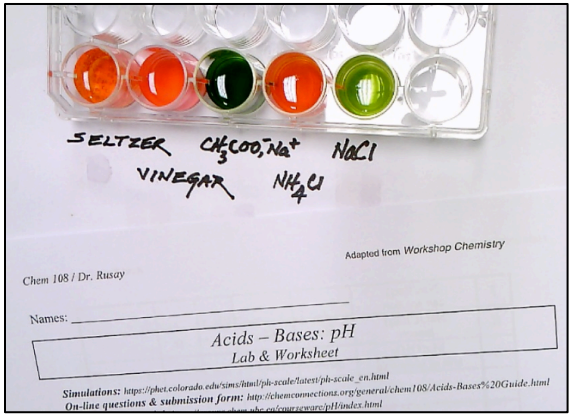
10	10^{-10}	0.0000000001
11	10^{-11}	0.00000000001
12	10^{-12}	0.000000000001
13	10^{-13}	0.0000000000001
14	10^{-14}	0.00000000000001

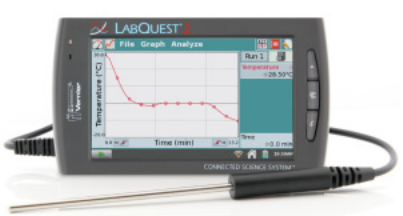
		Red Litmus	*Blue Litmus*	Solution pH		*pH Meter*	*Description*
				pH Paper	*Indicator*		
A	$HCl(aq)$ [stomach acid]	*red*	*red*	1	2	1.0	*acid*
B	$NaOH(aq)$ [drain cleaner]	*blue*	*blue*	13	14	13.0	*base*
C	$H_2O(l)$ [deionized water]	*red*	*blue*	7	7	7.0	*Neutral* (H_2O *is BOTH: acid & base)*
D	$H_2O(l)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



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

Lab pH: pH Meter

		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	



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