

Acid Base Color Chase Lab name

(40/1200 minutes)

Background: Svante Arrhenius explained how some solutions are acids and some are bases. Scientists then discovered chemicals that will change colors in the presence of an acid or base. These chemicals are called acid base indicators. We need to recognize the indicators listed in Table M, and understand how they work.

Pure water is neither acid nor base, it is said to be NEUTRAL. Neutral can mean two different things: Neutral means that there are no H^{+1} or OH^{-1} ions in solution, or the number of H^{+1} = the number of OH^{-1} ions.

Mathematically, each whole number change in pH is a 10X change in the hydrogen ion concentration because pH is an exponential scale. Acids with a pH of 2.0 are 10X stronger than acids with a 3.0 pH.

Each jump of a whole number of pH is a TEN TIMES change in strength. A solution with a pH of 6.2 is 100X less acidic than one with pH= 4.2 pH (a 2 fold increase is a 10x10 times change)

Acid Base Indicators will show different colors in solutions of different pH. They allow us to make qualitative measures of acid or base strengths. Adding acid lowers pH, while adding base increases pH. The acid base indicators give us a RANGE (an indication) of pH, not the exact pH.

This lab is to let you PLAY but also to think and learn. The lettered questions, A→O, are to think about. You don't have to write the answers out, but you should be able to.

PROCEDURE:

1. We will only use the deionized water (tap water is a bit acidic, ~pH 6.0). Get ~60 mL deionized water in a clean beaker. Put about 10 mL of the water into a second, smaller beaker. (enough to swirl)
2. Observe the water, and in the chart, write what color you see (it's clear). Follow the directions in order. For each step, write the color changes you see.
3. You must do the steps in order. Each trial has a different pattern.
4. The acid and base we are using are not very strong. Put a drop or two of each on your hand. Feel the difference between them. Weird, right?
5. Goggles must be on ALWAYS. Use just 1-2 drops of acid or base at a time.
6. Do all 5 TRIALS in any order, each one is separate from the others. Rinse the beaker out between trials.
7. Use colors from table M, don't imagine you see "fuchsia" or any other funky colors. Using colors at once is OK, Red + Blue or say purplely, Red + Yellow or say orangey. Pink or light pink. But nothing too wacky.

TRIAL 1 - METHYL ORANGE		
Step	Add to Beaker	color
1	Start with ~10 mL deionized water	
2	Add 2 drops of METHYL ORANGE	
3	Add 1-2 drops HCl - ACID	
4	Add 2-3 drops NaOH - BASE	
	repeat acid and base AGAIN	rinse beaker

A. The water starts clear. Why does the water change color when you put the methyl orange in it without adding acid or base?

B. What is the pH of water?

C. When you add the acid, does the pH increase or decrease?

D. When you add the base, does the pH increase or decrease?

TRIAL 2 - PHENOLPHTHALEIN		
Step	Add to Beaker	color
1	Water only	colorless
2	add 2 drops PHENOLPHTHALEIN	
3	Add 1-2 drops NaOH - BASE	
4	Add 2-3 drops HCl - ACID	
	repeat acid and base again	Rinse, smile

E. Phenolphthalein changes color from colorless to pink at what pH range?

F. If a solution with this indicator shows pink, can it be acidic?

G. If a solution with phenolphthalein is very pale pink, can that solution have a 7.7 pH ?

TRIAL 3 - BROMTHYMOL BLUE		
Step	Add to Beaker	color
1	Water only	colorless
2	add 3 drops BROMTHYMOL BLUE	
3	Add 2 drops NaOH - BASE	
4	Add 2-3 drops HCl - ACID	
	repeat add base then acid again	Rinse, smile

H. Why should you avoid words like magenta, or fuschia, and only use the colors listed in table M?

I. What color is any base solution that contains bromthymol blue?

J. What color do strong acids show with bromthymol blue?

TRIAL 4 - LITMUS		
Step	Add to Beaker	color
1	Water only	colorless
2	Add 2 drops LITMUS	
3	Add 1- 2 drops HCl - ACID	
4	Add 2-3 drops NaOH - BASE	
	repeat with acid, then base again	Rinse, smile

K. Litmus provides the weakest color change, red to blue, but it's really pale. (oh well). What solution pH could be pale purple?

L. What is the pH of pure water? What color is pure water with litmus? Isn't it great when the chem works great?

TRIAL 5 - BROMCRESOL GREEN		
Step	Add to Beaker	color
1	Water only	colorless
2	Add 2 drops BROMCRESOL GREEN	
3	Add 1- 2 drops HCl acid	
4	Add 2-3 drops NaOH base	
	repeat	Rinse, smile

M. Every time Bromcresol green is put into a base, what color shows?

N. Why that color?

O. If this indicator shows green, what is the pH range of the solution?

Color Chase Lab Questions

For each of these solutions + indicator combinations, tell the color that shows.
Use Table M and **page 584** in the big blue text book.

	Solution	LOOK UP THE approx. pH	Indicator	What Color Shows?
ex	black coffee	~5.0	methyl orange	yellow
1	0.055 M HCl _(AQ)		methyl orange	
2	ammonia		phenolphthalein	
3	vinegar		phenolphthalein	
4	lemon juice		litmus	
5	C ₂ H ₅ OH _(L) - ethanol		litmus	
6	black coffee		bromthymol blue	
7	milk		thymol blue	
8	Drano (lye)		thymol blue	
9	pure water		phenolphthalein	
10	pure water		bromthymol blue	
11	orange juice		thymol blue	
12	aqueous aspirin		thymol blue	

For each full number change in pH, there is a 10X change in strength because the pH scale is an exponential scale, because it is a logarithmic scale.

An acid with a pH of 2.0 is 10X stronger than an acid with a pH of 3.0.

A base of pH 7.5 is 100X LESS BASIC than a base with pH = 9.5

An acid of pH 1.0 is 1000X more acidic than an acid of pH = 4.0

An acid with a pH = 2.0 has 1×10^{-2} moles H^{+1} ions/Liter of acid

An acid with a pH = 4.0 has only 1×10^{-4} moles H^{+1} ions/Liter of acid

Remember...

If both solutions are acids, don't use the word base in the answer.

If both solutions are bases, don't use the word acid in the answer either.

	solution 1 pH	solution 2 pH	Solution #1 is ____ X _____ than solution #2
Ex.	3.7	4.7	#1 is <u>10X more acidic</u> than solution #2
Ex.	9.3	12.3	#1 is <u>1000X less basic</u> than solution #2
22	1.0	3.0	#1 is X than solution #2
23	1.9	5.9	#1 is X than solution #2
24	7.5	12.5	#1 is X than solution #2
25	10.8	12.8	#1 is X than solution #2
26	7.1	11.1	#1 is X than solution #2
27	11.1	9.1	#1 is X than solution #2
28	0.5	6.5	#1 is X than solution #2
29	4.9	6.9	#1 is X than solution #2
30	13.1	9.1	#1 is X than solution #2

Acid Base Color Chase Lab includes...

Cover Page	Define dynamic equilibrium	1 point
Fill in the data tables	5 trials	5 points
Table M Color Table	12 fill-in-the-blanks	6 points
#14—#30 questions	Multiple choice and fill in the blanks	13 points
This lab is due on...		25 points total

There is no conclusion for this lab (thank you very much)

**Table M
Common Acid–Base Indicators**

Indicator	Approximate pH Range for Color Change	Color Change
methyl orange	3.1–4.4	red to yellow
bromthymol blue	6.0–7.6	yellow to blue
phenolphthalein	8–9	colorless to pink
litmus	4.5–8.3	red to blue
bromcresol green	3.8–5.4	yellow to blue
thymol blue	8.0–9.6	yellow to blue