Lab 10 Measuring pH

Oklahoma Standard: HS-PS1-2

Matter and its interactions (chemical reaction explanations)

Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, knowledge of the patterns of chemical properties, and formation of compounds.

Indicator Preparation (red cabbage juice)

Supplies & Equipment	Consumables	Safety PPE
Indicator Production • Pot (*for boiling cabbage*) • Jars with lids (*for storing*) • Large kitchen knife • Large spoon or stirrer • Colander • Cookie pan	Indicator Production • Water • Red Cabbage • Coffee filters	Indicator Production • Safety glasses • Cooking mitts

Lab Experiment and Testing

Supplies & Equipment	Consumables	Safety PPE
Lab ware • Glassware (beakers) • Pipettes • Periodic table	pH indicators solution • Red cabbage juice • Dyed/dried coffee filters Solutions for testing • *Select from solution matrix* • Test Crisco and olive oil • Test common candy (Gummies/Twizzlers) Disposable testing aids • Paper plates • Small cups • Q-tips®	Testing PPE • Laboratory gloves • Lab apron or equivalent • Access to eye wash

Suggested Solutions for Testing (Matrix of Solutions)

pH	Common name	Chemical name	Chemical formula
2.00	Vinegar	acetic acid	CH_3COOH
2.50	Lemon juice	citric acid	$C_6H_8O_7$
3.00	Vitamin C	ascorbic acid	$C_6H_8O_6$
3.50	Club soda	carbonated water	H_2CO_3
4.40	Peroxide	hydrogen peroxide	H_2O_2
4.80	Apple juice	malic acid	$C_4H_6O_5$
6.50	Milk	lactic acid	$C_3H_6O_3$
7.00	Red cabbage	anthocyanin	$C_{15}H_{11}O^+$
7.00	Distilled water	water	H_2O
8.30	Baking soda	sodium bicarbonate	$NaHCO_3$
9.50	Borax	sodium borate	$Na_2[B_4O_5(OH)_4]\cdot 8H_2O$
10.50	Milk of magnesia	magnesium hydroxide	$Mg(OH)_2$
11.00	Bleach	sodium hypochlorite	NaClO
11.60	Ammonia	nitrogen trihydride	NH_3
14.00	Lye	sodium hydroxide	NaOH

General Safety Processes

Always dilute base solutions by adding base to water and not water to base. Adding water to concentrated bases may cause violent boiling of the solution and splashing. Ammonium hydroxide should be handled in a chemical fume hood to avoid breathing ammonia gas. If you wish to dilute an acid with water before neutralizing it with a base (e.g., sodium hydroxide, potassium hydroxide or sodium bicarbonate), always add acid to water; never add water to acid. Perform all neutralizations within a fume hood while wearing nitrile rubber gloves, a lab coat, and eye protection.

NOTE: DO NOT MIX BLEACH AND VINEGAR. WHEN COMBINED THEY YIELD A TOXIC CHLORINE GAS.

NOTE: ONLY PERFORM THIS LAB UNDER THE SUPERVISION OF AN ADULT.

NOTE: PRINT AND REVIEW THE SDS/MSDS CHEMICAL DESCRIPTIONS, CAUTIONS AND WARNINGS FOR EACH SOLUTION. FOLLOW SAFETY GUIDELINES LISTED ON THOSE SHEETS.

(HoneycuttScience.com Lab 01 has many applicable SDS sheets for convenient reference).

Summaries of Processes

Summary of Preparation

Boil red cabbage (slice into small pieces first). Separate fiber from cabbage juice with colander. When cool, pour/store juice in jars with lids. Use remaining juice to dye coffee filters. Dry filters on a cookie rack at ambient conditions

Summary of pH Art Activity

Place filters in a paper plate to reduce clean-up needs. Use small cups to portion out solutions for student groups. Use Q-tips or straws to drop various solutions on a dyed/dried filter. Create art using red/blue/green patterns on the filter according to approximate pH.

Summary of Neutralization Activity

Use diluted acids and alkaline solutions to combine for neutralized products. Add a diluted base to a beaker containing a small amount of indicator. Wearing gloves use a pipette placed inside the beaker and about two inches from the surface of the diluted base. Slowly drip the acid into the solution. Observe the change in color. Once the solution has changed to clear (or purple) the neutralization has completed.

Make Predictions (Gummy Bear and Twizzlers) / (Crisco and Olive Oil)

Set up an experiment with controls and test cases (independent and dependent variables). Use Gummy Bears ™/Gummy Worms and Twizzlers® candy. Predict whether an acid or base will dissolve the candy fastest and most completely. (Refer to "Technique 21" for guidance).

Steps

1. Complete student handout from Lab 10 honeycuttscience.com.
2. Prepare indicator using safety equipment and referring to summary of preparation.
3. Create art on coffee filters as shown on video from Lab 10.
4. Read cautions and advisories from Lab 10 web page prior to beginning neutralization activity.
5. Neutralize diluted alkaline solutions following guidelines listed here.
6. Conclude by balancing equations listed here as supplementary problems. Check answers through web search confirmation.

Supplementary Problems (balancing equations)

Refer to the periodic table to find and identify properties for the following elements: C. Cl, H, Na, O. Using research tools available to you and/or your science textbook, identify the number of electrons in each element's outermost shell, identify elements in similar locations on the table, form ideas related to chemical reactions based on your findings.

$CH_3COOH + NaOH =>$

$C_4H_6O_5 + NaOH =>$

$H_2O_2 + NaOH =>$

$CH_3COOH + NaHCO_3 =>$

$C_4H_6O_5 + NaHCO_3 =>$

$H_2O_2 + NaHCO_3 =>$

$H_2CO_3 + NaHCO_3 =>$

$C_4H_6O_5 + NaClO =>$

Does combining apple juice and bleach make table salt, carbon dioxide and water?

$C_4H_6O_5 + 6\ NaClO => 6\ NaCl + 4\ CO_2 + 3\ H_2O$