Name: Date:

HANDS-ON LAB

Investigating Acids and Bases

Acids are compounds that dissociate when dissolved in water, giving off positively-charged hydrogen ions. Acids have a pH value lower than 7, react with active metals, and turn blue litmus paper red. Acids also tend to have a sour taste. Bases are compounds that give off hydroxide ions when dissolved in water. Bases have a pH value higher than 7, typically have a slippery feel, and turn red litmus paper blue. Basic compounds do not react with active metals. Neutral compounds contain an equal number of hydrogen and hydroxide ions, and have a pH value of 7. An indicator is a tool used to determine the pH of a solution. One indicator that will be used in this lab is red cabbage. Red cabbage contains a pigment molecule called flavin (an anthocyanin). The anthocyanin pigments present in red cabbage will turn yellowish-green in the presence of a base, and red in the presence of an acid.

PREDICT

Which indicator(s) do you think will most accurately measure pH? How will you determine which indicator is most accurate?

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MATERIALS

- beaker, 250 mL (for rinsing)
- conductivity meter with 9 volt battery
- litmus paper, blue (6)
- litmus paper, red (6)
- magnesium ribbon, 20 cm
- pH probe
- pH indicator paper (6)
- pipette, plastic disposable (7)
- red cabbage solution, 30 mL
- unknown solution, 10 drops (6)
- water, deionized (for rinsing)
- well plate

PROCEDURE

1. Place 10 drops of Unknowns 1–6 in 6 separate wells in your well plate.
2. Place the conductivity indicator (green circuit-board-like structure) into Unknown 1. If the LED bulb blinks, record “yes” in the data table. If not, record “no.” Rinse the probes with deionized (DI) water over a 250 mL beaker, and place the conductivity indicator into Unknowns 2–6, rinsing the probes each time a new unknown is tested.
3. Dip a piece of blue litmus paper into Unknown 1 and record the color change in the data table. If you see no color change, record “none.” After recording your data, place the used litmus paper on a paper towel. Repeat for each unknown.
4. Repeat Step 3, using red litmus paper this time.
5. Repeat Step 3, using pH paper this time. Use the label on the side of the pH paper container to determine the pH of each unknown. When you are done, throw away all used pH paper.
6. Place the pH probe in Unknown 1. Record the pH shown in the data table. Rinse the pH probe with deionized water before placing it in each unknown.
7. Place 5 drops of cabbage indicator into each well plate. Record the color change.
8. Place a piece of magnesium metal into each well plate. If a chemical reaction is observed (indicated by the presence of bubbles), record “yes” in the data table. If not, record “no.”

9. Use the choices provided in the reference table to determine the identity of each substance. Record the identity of each substance in the data table.

10. Pour the contents of your well plate into a chemical waste container. Then rinse and dry the well plate.

DATA TABLE: pH INDICATOR RESULTS

UNKNOWN	1	2	3	4	5	6
Conducts Electricity (Yes or no)						
Blue Litmus Paper (Red or no change)						
Red Litmus Paper (Blue or no change)						
pH Paper (Use key on container to determine pH)						
pH Probe (Record value displayed)						
Cabbage Indicator (Record color change)						
Reacts with Metal (Yes or no)						
Acid, Base, or Neutral						
Identity of Unknown						

REFERENCE TABLE: SUBSTANCE CHOICES

SUBSTANCE	pH	SUBSTANCE	pH
Stomach acid (HCl)	1.0	Distilled water	7
Lemon juice	2.0	Baking soda	8.3
Vinegar	2.2	Soapy water	10
Orange juice	4.2	Ammonia	11
Hydrogen peroxide	5.9	Bleach	12.1
Milk	6.6	Drain cleaner	14

ANALYZE

1. Based on your results, which indicator(s) are the most precise indicator of pH (such as litmus paper, pH paper, cabbage juice, etc.)? Which indicator(s) are the least precise?

2. Describe the hydrogen ion concentrations in each of the six solutions.

3. Look at the table of substance choices. What do all the basic compounds have in common (in terms of their use)?

EXPLAIN

Explain how you determined which of the unknowns were acids, bases, and neutral substances. Use the following format for your explanation.

Claim Which substances were acids, which were bases, and which were neutral?

Evidence Give at least three specific examples from your data table that support your claims.

Reasoning Explain how the evidence you cited supports your claim. How do you know that the unknown substance is acidic, basic, or neutral? How does the evidence support your ideas?