Science 10: Indicators: Testing pH of Acids + Bases

Name:_____ **Block:** _____
Group Members:_____ **Date:** _____/_____/_____
Due Date:_____ **Drop Date:**_____

The report is submitted in full, **on the due date**. If you are absent on the day, the report is expected to be submitted electronically. Late reports are penalized, and will *not accepted past the drop date*.

Criteria	Student Self Evaluation	Teacher Assessment
Predictions: Student has used the background knowledge provided to make reasonable predictions with regards to the pH of the test solutions.	**/3**	**/3**
Flow Chart: a flow chart diagram of the procedure(s) completed individually by each group member ***before the lab!*** **Pre-Lab Questions:** displays a critical understanding of the background theory.	**/18**	**/18**
Data, Results: Provides results & detailed observations (and diagrams where appropriate) that are presented in **correctly labelled** tables with **descriptive, numbered titles**.	**/12**	**/12**
Follow up Questions: Correctly identifies and explains the theory relating to the experiment and supports this with accurate observations & data.	**/10**	**/10**
Conclusion: Identifies and defines important concepts and principles relevant to the experiment by relating back and answering to the objective and hypothesis.	**/3**	**/3**
Presentation: Practical report is presented in third person past tense & in the **correct format**. Is written fluently and provides **appropriate section headings** and accurate referencing. ***Tables & graphs*** have numbered headings & descriptive titles. Data & calculations may be hand written, however the remainder of the report is to be **word-processed.**	**/2**	**/2**
Results Summary	**/48**	**/48**

We will be doing the lab on _____.

In order to be ready to go, you need to complete the following sections of your lab report:

- ☐ *Flow Chart*
- ☐ *Pre-Lab Questions*

Background Reading:

What are acids and bases?

Many common pure substances can be classified according to whether they are acids or bases. Acids produce **hydrogen ions** (H^+) and bases produce **hydroxide ions** (OH^-) when dissolved in solution.
The **concentration** of hydrogen ions refers to the number of hydrogen ions in a specific volume of solution.

Solutions with a high concentration of hydrogen ions are highly acidic.

Similarly, solutions with a high concentration of hydroxide ions are highly basic.

When an acidic solution is mixed with a basic solution, the solutions can **neutralize** each other, which means that the acidic and basic properties are in balance.

What is pH?

Testing the pH of a solution is a way of measuring its concentration of hydrogen ions, $H^+(aq)$. The **pH scale** is a number scale that indicates how acidic or basic a solution is. **Acids** have a pH below 7 and **bases** have a pH above 7. Neutral solutions have a pH of 7. On the pH scale, one unit of change represents a **10-fold change** in the degree of acidity or basicity. For example, a two unit drop in pH is a 10^2 or 100 times increase in acidity.

What are pH indicators?

pH indicators are chemicals that change colour depending on the pH of a solution.

- **Litmus paper** can determine whether a solution is acidic or basic. Blue litmus paper turns red in an acidic solution (below pH 7). Red litmus paper changes to blue in abasic solution (above pH 7),
- A universal indicator contains a number of indicatorsthat turn different colours depending on the pH of the solution.
- **Phenolphthalein, bromothymol blue, indigo carmine, methyl orange**, and **methyl red** are other common pH indicators. Each determines pH within a different range.

Figure 1: pH values of common substances

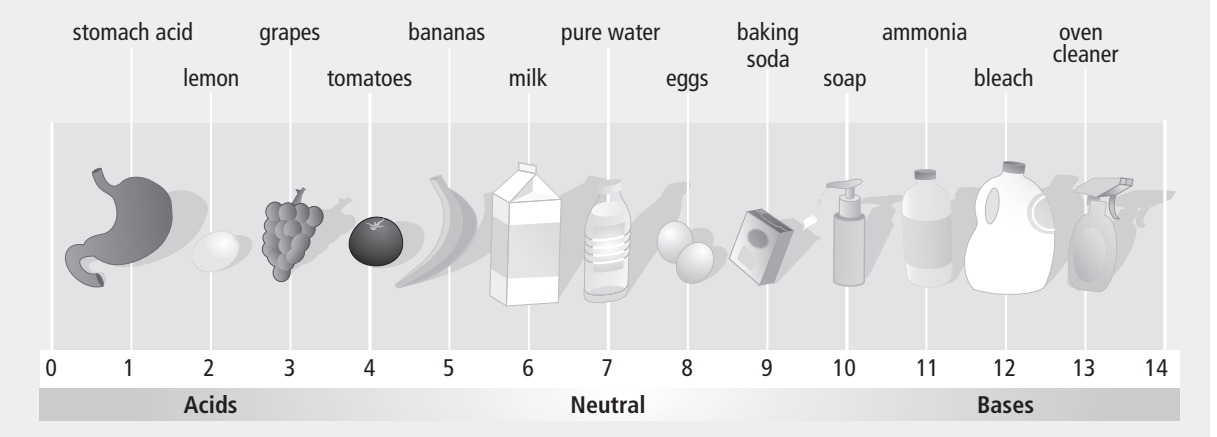
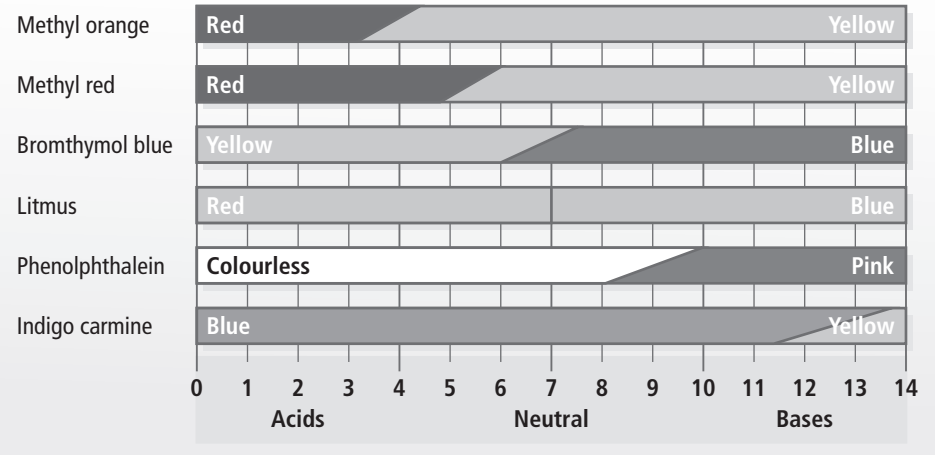


Figure 2: Common acid-base indicators and their pH colour change



Pre-Lab Questions:

1. Describe the difference between the chemical nature of an **acid** and a **base.** **/ 2 marks**

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2. Describe the pH scale and what it measures? **/ 2 marks**

3. What is the pH of a ***neutral solution***? *Explain,* in terms of ion concentration. **/ 2 marks**

4. List 3 common pH indicators and the range of their pH color change. **/ 3 marks**

   i)

   ii)

   iii)

5. The pH scale is a ***base 10 scale***. Explain what this means in terms of the degree of acidity or basicity as the values increase from 0 to 14 on the scale. **/ 1 mark**

6. Consider a change in pH from pH=3 *(grapes)* to pH=5 *(banana)*. **/ 1 mark**
   This means a banana is _____X more acidic than a grape.

7. Complete the following table using the Common acid-base indicators provided in Figure 2 *(previous page).* ***/6 marks***

Substance	pH Value	Acid or Base	pH Indicator	Colour of pH Indicator
black coffee	5		litmus	
milk of magnesia	10		phenolphthalein	
battery acid	0		bromothymol blue	
sea water	8		indigo carmine	
orange juice	3		methyl orange	
liquid drain cleaner	14		methyl red	

Testing the pH of Common Household Products

Purpose:

In this lab, you will be testing a variety of household products with pH indicators to establish accurate pH ranges for each solution. This experiment will inform you of the pH of various solutions, allow you to practice your safe l aboratory skills, and give you practice analyzing pH indicator data.

Safety Instructions:

- Long hair must be tied up and loose clothing removed or restrained
- Wear safety goggles for the entire time you have chemicals on your lab bench and during clean up
- Treat all solutions with caution
- Wash your hands thoroughly and immediately if a solution gets on your skin
- pH indicators can be strong dyes and may discolour your clothing upon exposure

Predictions: **/ 3 marks**

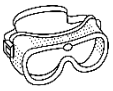
Before starting the lab, predict if each solution will be acidic, basic or neutral.

**Your teacher will tell you which solutions you are testing*

Solution	Prediction: Acidic, Basic or Neutral?

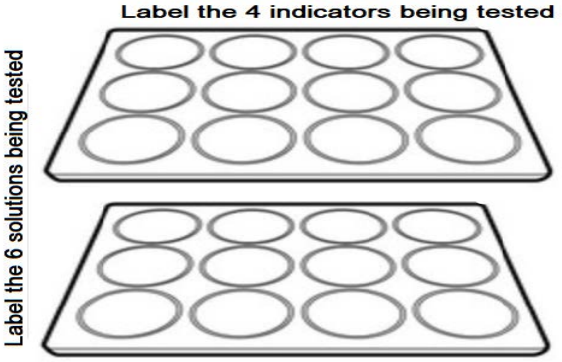
Procedure: Use this to **prepare a flow chart** for next class.

(FLOW CHART MUST be completed to participate in the lab!)



1. Collect **two spot plates**. Rinse both thoroughly with tap water and use a paper towel to dry all the wells.

2. Collect a blank piece of paper. Set up your spot plates on the piece of paper like your teacher has drawn on the board.



3. You will be testing the pH of **6 different solutions**. Each solution you will test with **4 different pH indicators**: methyl orange, bromothymol blue, phenolphthalein, and litmus paper.

For EACH solution, do the following:

a. Using the dropper provided, put 2-3 drops of one solution in each well of one horizontal row.

b. In your data table, record the appearance of the solution before adding any indicator. Note the colour and if the solution is clear or cloudy.

c. Add 1-2 drops of pH indicator to the proper well. For litmus paper, carefully place a small piece of litmus paper directly into the well.

d. Swirl the spot plate **gently** to mix. (If the contents of different wells mix, your data will be compromised and you will have to start again!)

e. Immediately record the results in your data table.

4. Repeat the steps you followed in 1 for each household solution. Once you have tested all solutions with all pH indicators, please have someone in your group take a picture of your spot plates with the labels clearly visible so you have it for your records.

Clean Up:

1. All solutions can go down the sink drain. **Litmus paper should be removed from the wells and placed in a garbage can using the tweezers provided.**

2. Rinse the spot plate thoroughly with water and place in the dish rack to dry.

3. Wash your hands.

Flow-Chart *(must be completed to participate in the lab):*

Checked by teacher

Data & Results:

Table 1:_____

Solution Name	Solution Description (without any indicator)	Result when methyl orange added	Result when bromothymol blue added	Result when phenolphthalein added	Change in litmus paper when dipped in solution

Follow-Up Questions: **(10 marks)**

1. Using your pH indicator table, determine the approximate pH range of each solution tested. Be as specific as you are able.

Solution	pH Range

2. Draw a scale and rank the six solutions from most acidic to most basic.

3. When water from a pond is tested by a chemistry class with phenolphthalein, it stays clear. When litmus paper is dipped in the solution, the paper turns blue. What is the approximate pH of the pond water?

4. An unknown solution, solution B, is tested with both bromothymol blue and methyl orange. Both tests give a yellow result. What is the approximate pH of the solution B?

5. Your friend tests a solution and tells you these results. When tested with phenolphthalein, it turned bright pink, and when tested with litmus paper, the paper turned red. What can you conclude from your friend's results?

Conclusion: **(3 marks)**

- Briefly summarize experimental results.
- Answer objective/experimental question.
- Discuss any sources of experimental error.