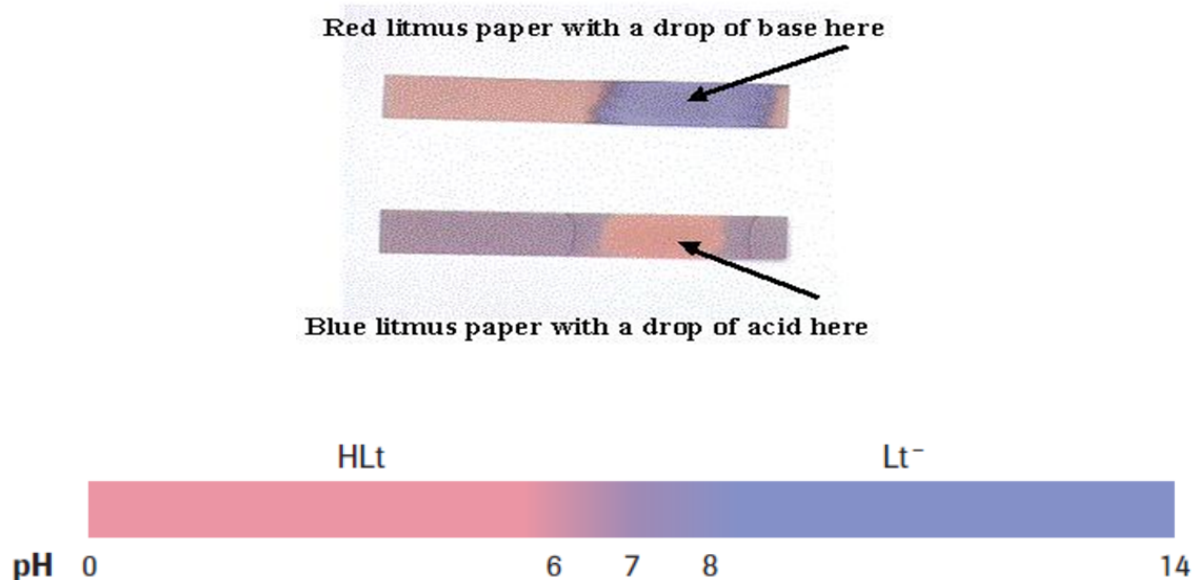


Outcome 2

Topic 3 – How Acid Base Indicators work

- Acid-base indicator – substance that changes color when the acidity of the solution changes pH

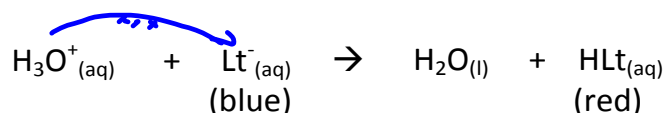
- Eg. Litmus turns red in an acidic solution and blue in a basic solution



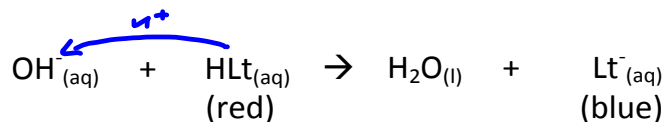
- Indicators are chemicals that can exist in two forms, each having their own distinctly different color

- The chemicals are very complex so the actual formula isn't written, we just use abbreviations
- Ex. Litmus is abbreviated Lt
- The two forms differ only by a hydrogen ion
- The two forms of litmus are HLt (red) and Lt⁻ (blue)

Reaction of an acid with litmus



Reaction of a base with litmus



Acid–Base Indicators at 298.15 K

Indicator	Suggested Abbreviation(s)	pH Range	Colour Change as pH Increases
methyl violet	HMv(aq) / Mv ⁻ (aq)	0.0 – 1.6	yellow to blue
cresol red	H ₂ Cr(aq) / HCr ⁻ (aq)	0.0 – 1.0	red to yellow
	HCr ⁻ (aq) / Cr ²⁻ (aq)	7.0 – 8.8	yellow to red
thymol blue	H ₂ Tb(aq) / HTb ⁻ (aq)	1.2 – 2.8	red to yellow
	HTb ⁻ (aq) / Tb ²⁻ (aq)	8.0 – 9.6	yellow to blue
orange IV	HOr(aq) / Or ⁻ (aq)	1.4 – 2.8	red to yellow
methyl orange	HMo(aq) / Mo ⁻ (aq)	3.2 – 4.4	red to yellow
bromocresol green	HBg(aq) / Bg ⁻ (aq)	3.8 – 5.4	yellow to blue
methyl red	HMr(aq) / Mr ⁻ (aq)	4.8 – 6.0	red to yellow
chlorophenol red	HCh(aq) / Ch ⁻ (aq)	5.2 – 6.8	yellow to red

- Several indicators can be used to determine the approximate pH of a solution

eg) Solution 1: indigo carmine is blue ∴ pH is
 thymol blue is blue ∴ pH is
 thymolphthalein is blue ∴ pH is

∴ Solution 1 has a pH between

Solution 2: methyl violet is blue ∴ pH is
 orange IV is yellow ∴ pH is
 methyl orange is red ∴ pH is

∴ Solution 2 has a pH between

▶ mini Investigation pH of a Solution

In this activity, you will design an experiment to challenge your fellow students. Imagine that you have a solution with a pH known only to you. How can you give clues about its pH?

Materials: index cards or paper

- On one side of the card, write the pH of your solution.

- On the other side, write the names and colours (at that pH) of three or four indicators.
- Hand your card, "indicator" side up, to another student. See how close he or she can come to determining the pH of your solution without looking at the answer.

In chemical analysis of separate samples of an unknown solution, phenolphthalein was colourless, bromothymol blue was blue, and phenol red was red. What is the estimated pH and hydronium ion concentration?

Solution

Indicator	Colour	pH
phenolphthalein	colourless	≤ 8.2
bromothymol blue	blue	≥ 7.6
phenol red	red	≥ 8.0



LAB EXERCISE 6.B

Report Checklist

- | | | |
|-------------------------------------|------------------------------------|--|
| <input type="checkbox"/> Purpose | <input type="checkbox"/> Design | <input checked="" type="checkbox"/> Analysis |
| <input type="checkbox"/> Problem | <input type="checkbox"/> Materials | <input type="checkbox"/> Evaluation |
| <input type="checkbox"/> Hypothesis | <input type="checkbox"/> Procedure | |
| <input type="checkbox"/> Prediction | <input type="checkbox"/> Evidence | |

Using Indicators to Determine pH

One Design for determining the pH of a solution is testing the solution with indicators. Include a table of indicators and pH as part of your Analysis.

Purpose

The purpose of this lab exercise is to use the concept of acid–base indicators and the reference table of indicator colours to determine the pH of three different solutions.

Problem

What is the approximate pH of three solutions?

Design

The solutions were labelled A, B, and C. Samples of each solution were tested with different indicators.

Evidence

- Solution A: After addition to samples of the solution, methyl violet was blue, methyl orange was yellow, methyl red was red, and phenolphthalein was colourless.
- Solution B: After addition to samples of the solution, indigo carmine was blue, phenol red was yellow, bromocresol green was blue, and methyl red was yellow.
- Solution C: After addition to samples of the solution, phenolphthalein was colourless, thymol blue was yellow, bromocresol green was yellow, and methyl orange was orange.

3. According to the table of acid–base indicators in your data booklet, what is the colour of each of the following indicators in the solutions of given pH?

- | | |
|---|---|
| (a) phenolphthalein in a solution with a pH of 11.7 | (b) bromothymol blue in a solution with a pH of 2.8 |
| (c) litmus in a solution with a pH of 8.2 | (d) methyl orange in a solution with a pH of 3.9 |

4. Complete the Analysis for each of the following diagnostic tests. If the specified indicator is added to a solution, and the solution turns the given colour, then the solution's pH is ____.

- | | | |
|----------------------|---------------------------|------------------------------|
| (a) methyl red (red) | (b) alizarin yellow (red) | (c) bromocresol green (blue) |
|----------------------|---------------------------|------------------------------|