

Name: _____

Blk: _____ Date: _____

Chemistry 12
ACID BASE PART II Lesson # 17
INDICATORS CONTINUED

For today's lesson we first need to review our elementary school knowledge of COLOURS

1. To make Green you mix:

blue + yellow

2. To make Orange you mix:

red + yellow

3. To make Purple you mix:

red + blue

4. To make Brown you mix:

all of the above

A **UNIVERSAL INDICATOR** is an indicator solution that changes colour several times over a range of pH values.

Example 1. Identify the colour and pH range that a UNIVERSAL INDICATOR made up of Methyl Orange, Bromothymol Blue and Phenolphthalein would produce.

Ind	pKa	Hln	In ⁻
M.O	3.8	red	yellow
B.B.	6.8	yellow	blue
P	9.1	—	pink

pKa = mid point

$$M.O = 3.2 + 4.4 = 7.6 \div 2 = 3.8$$

$$B.B = 6.0 + 7.6 = 13.6 \div 2 = 6.8$$

$$P = 8.2 + 10.0 = 18.2 \div 2 = 9.1$$

Ind \ pH	0-3.8	3.8-6.8	6.8-9.1	9.1-14
M.O	red	yellow	yellow	yellow
B.B	yellow	yellow	blue	blue
P	—	—	—	pink
Combo:	orange	yellow	green	purple

Example 2. When a unknown substance was tested with a mixed indicator of Methyl Red, Phenol Red and Phenolphthalein the solution was YELLOW Give the pH range for the unknown substance.

Ind	pKa	HIn	In ⁻
M.R	5.4	red	yellow
P.R	7.3	yellow	red
P	9.1	—	pink

pKa = midpoint

$$M.R = 4.8 + 6.0 = 10.8 \div 2 = 5.4$$

$$P.R = 6.6 + 8.0 = 14.6 \div 2 = 7.3$$

$$P = 9.1$$

Ind \ pH range	0-5.4	5.4-7.3	7.3-9.1	9.1-14
M.R	red	yellow	yellow	yellow
P.R	yellow	yellow	red	red
P	—	—	—	pink
combo	orange	yellow	orange	peachy

∴ 5.4 to 7.3 is yellow

②

Example 3. A mixture of Thymol Blue and Alizarin Yellow is put in a solution with $[OH^-] = 1.0 \times 10^{-4} M$. Use your table of Acid-Base indicators to determine the colour of this mixed indicator. pH ?

Ind	pKa	HIn	In ⁻
T.B _I	2.0	red	yellow
T.B _{II}	8.8	yellow	blue
A.Y	11.1	yellow	red

$$T.B_I = 1.2 + 2.8 = 4.0 \div 2 = 2.0$$

$$T.B_{II} = 8.0 + 9.6 = 17.6 \div 2 = 8.8$$

$$A.Y = 10.1 + 12.0 = 22.1 \div 2 = 11.1$$

Ind \ pH	0-2.0	2.0-8.8	8.8-11.1	11.1-14
T.B	red	yellow	blue	blue
A.Y	yellow	yellow	yellow	red
combo	orange	yellow	green	purple

$$pOH = -\log(1.0 \cdot 10^{-4}) = 4.00$$

$$pH = 14.000 - 4.00 = 10.00$$

∴ GREEN