Name:____________________
Blk:______Date:______________

Chemistry 12
ACID BASE PART II Lesson # 17
INDICATORS

An INDICATOR is a mixture of a weak organic acid and it's conjugate base.

To simplify matters we will use the FORMULA HIn to represent the acid and In^- to represent the base.

For a list of INDICATORS refer to page 7 in your DATA BOOKLET or pg 335 in your HEBDEN text book.

Because an indicator is a weak acid in water the generic chemical reaction is:

$$HIn + H_2O(l) \rightleftharpoons In^- + H_3O^+$$

HIn (yellow), In^- (red), 5.2 - 6.8

For the INDICATOR -> Chlorophenol Red
The colour of **HIn** is yellow while the colour of **In-** is red.

In the presence of an ACID (H_3O^+) the above reaction is going to shift to the reactants and the colour that predominates will be yellow.

In the presence of a BASE (OH^- react with H_3O^+ ∴ ↓ $[H_3O^+]$) the above reaction is going to shift to the products and the colour that predominates will be red.

Some important terminology:
END POINT/ TRANSITION POINT- The pH where the colour of an indicator changes.

EQUIVALENCE POINT - (stoichiometric point) where moles acid equals moles of base.

If the indicator is chosen correctly, the indicator should change colour at (or very close to) the equivalence point.

Example 1. Calculate the END POINT for the indicator Chlorophenol Red.

(mid point) is determined by adding the 2 values for the pH range together, then divide that value by 2.

$5.2 + 6.8 = 12.0 \div 2 = 6.0$

At the END POINT of an indicator the [HIn] = [In-]. Therefore we can use this relationship to calcalate the indicator's **Ka** using the MIDPOINT of the indicator's COLOUR CHANGE.

Indicator equation: $HIn + H_2O(l) \rightleftharpoons In^- + H_3O^+$

Ka expression: $Ka = \frac{[In^-][H_3O^+]}{[HIn]}$; if [HIn] = [In⁻]

Conclusion: $Ka = [H_3O^+]$

If Ka = [H₃O+]

then -log (Ka) = - log [H₃O+]

pKa = pH

6.0

Conclusion: ∴

an indicator's midpoint value can be used to calculate it's Ka value

$Ka = antilog(-midpoint)$

Ka (c.R) = antilog (-6.0)

$Ka = 1 \cdot 10^{-6}$

Example 2. Ethyl Orange is RED at pH < 3.4 and YELLOW at pH > 4.8. What is the approxmate value of the K_a for Ethyl Orange?

mid point = 3.4 + 4.8 = 8.2 ÷ 2 = 4.1

$Ka = antilog(-midpoint)$

$= antilog(-4.1)$ → $8 \cdot 10^{-5}$

Example 3. Given that an indicator has a K_a value of 2.5 x 10-5 , what is the transition point of the indicator? Identify the indicator.

(mid point) $pH = -\log(Ka)$

$= -\log(2.5 \cdot 10^{-5})$

$= 4.60$

B.G = 3.8 + 5.4 = 9.2 ÷ 2

= 4.6

indicator is Bromcresol green

Example 4. Alzarin Yellow R changes from yellow to red at pH = 11.0. If Aliz- ion is RED, what colour is Alzarin Yellow R in 1.0 x 10-5 M NaOH?

midpoint

$HIn + H_2O(l) \rightleftharpoons In^- + H_3O^+$

HIn: yellow; In⁻: red

∴ basic indicator

1 – 11.0 ⇒ yellow

11.0 – 14.0 red

pH of 1.0 ·10⁻⁵M NaOH

$[OH^-] = 1.0 \cdot 10^{-5}M$

$pOH = -\log(1.0 \cdot 10^{-5})$

$= 5.00$

pH = 14.000 - 5.00 = 9.00

∴ will be yellow!

SEATWORK/HOMEWORK: Exercises 108-114 pgs 162-163 in HEBDEN

PLO's : O1-O5