

Chemistry 12
Worksheet 4-7—Indicators

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Name _____

Due Date _____

Correct & Hand In by _____

This worksheet covers material from class notes and Student Workbook pages 159-163

1. An indicator HInd is yellow in 0.1M NaOH and blue in 0.1M HCl. The pH range in which the colour change occurs in this indicator is 3.6 - 5.2.
- a) Write the *equilibrium equation* describing this indicator.(1)

- b) What is the colour of HInd? _____ What is the colour of Ind⁻? _____ (2)
- c) What is the pH at the transition point of this indicator? _____ (1)
- d) What is the value of pKa for this indicator? _____ (1)
- e) What is the Ka of this indicator? _____ (1)
- f) At pH = 2.2, this indicator is the colour _____ and [HInd] (>,<=) ____ [Ind⁻].(2)
- g) At pH = 7.0, this indicator is the colour _____ and [HInd] (>,<=) ____ [Ind⁻].(2)
- h) At pH = 11.3, this indicator is the colour _____ and [HInd] (>,<=) ____ [Ind⁻].(2)
- i) At pH = 4.4, this indicator is the colour _____ and [HInd] (>,<=) ____ [Ind⁻].(2)
- j) At pH = 4.3, this indicator is the colour _____ and [HInd] (>,<=) ____ [Ind⁻].(2)
- k) In 0.001M HNO₃, this indicator is the colour ____ and [HInd] (>,<=) ____ [Ind⁻].(2)
- l) In 0.001M KOH, this indicator is the colour _____ and [HInd] (>,<=) ____ [Ind⁻].(2)
- m) At the *transition point*, is [H₃O⁺] = Ka (indicator.)? _____(1)

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2. A solution turns yellow when Orange IV is added and red when methyl orange is added. Give the approximate pH range of the solution. (1)

Answer pH = _____ - _____

3. A solution turns yellow when chlorophenol red is added and also yellow when methyl orange is added. Give the approximate pH range of the solution. (1)

Answer pH = _____ - _____

4. A solution turns magenta when phenolphthalein is added and yellow when alizarin yellow is added. Determine the approximate $[H_3O^+]$. (1)

Answer $[H_3O^+] =$ _____

5. A 0.10 M solution of a weak acid HX turns red in both chlorophenol red and in neutral red indicator.

- a) Determine the approximate pH of this solution of HX. _____ (1)
- b) Determine the K_a of the weak acid HX (Not the K_a (indicator)!) (Hint: Use an ICE table!) (2)

Answer $K_a =$ _____

6. An indicator "Gupta Green" (HGg) turns yellow when $[H_3O^+]$ drops below 1.2×10^{-4} M and turns blue when $[H_3O^+]$ rises above 1.8×10^{-3} M. (Notice 2 SD's)

- a) Find the pH range over which the indicator changes colour. (2SD's) (2)

pH Range _____ - _____

- b) Determine the pKa of the indicator "Gupta Green". (1) _____

- c) What colour would 0.00019 M HCl be in this indicator? (1) _____

- d) What colour would 0.010 M NaOH be in this indicator? (1) _____

- e) What colour would 0.10 M CH_3COOH be in this indicator?
(Show how you got $[\text{H}_3\text{O}^+]$) (2)

Answer _____

7. An indicator HInd turns yellow in 0.10 M HCl and blue in 0.10 M NaOH.

- a) Write the equation describing the *equilibrium* in HInd. (1)

- b) What colour is HInd? (1) _____ What colour is Ind^- ? (1) _____

- c) HInd is green in the range $\text{pH} = 5.4$ to $\text{pH} = 6.2$. Determine the K_a of HInd.(1)

$K_a =$ _____

- d) When a few drops of HInd are added to a weak acid HA_1 , the colour is yellow. Which is the stronger acid, HInd or HA_1 ? (1)

Answer _____ is the stronger acid.

- e) When a few drops of HInd are added to a weak acid HA_2 , the colour is blue. Which is the stronger acid, HInd or HA_2 ? (1)

Answer _____ is the stronger acid.

- f) Which acid is stronger, HA_1 , or HA_2 ? (1) _____

- g) List the acids HInd, HA_1 and HA_2 in order of strength from strongest to weakest.(1)

_____ > _____ > _____

- h) List the bases Ind^- , A_1^- , and A_2^- , in order of strength from strongest to weakest.(1)

_____ > _____ > _____