

# Indicadores de pH

Elaborado por:  
Gustavo Gomez Sosa  
Facultad de Quimica UNAM

QUÍMICA ANALÍTICA I CLAVE 1402  
Grupo 13, semestre 2010-1

# INDICADORES ACIDO-BASE

## Definición de indicador ácido-base:

Acido o base orgánicos débiles cuya forma sin disociar difiere del correspondiente acido o base conjugados. El cambio de color se debe a un cambio estructural inducido por la protonación o desprotonación de la especie. Los indicadores ácido-base tienen un intervalo de viraje de unas dos unidades de pH, en la que cambian la disolución en la que se encuentran de un color a otro, o de una disolución incolora, a una coloreada.

## Indicador para base



## Indicador para acido



Tomando en cuenta solo un indicador "ácido".

$$K_a = \frac{[\text{H}_3\text{O}^+][\text{In}^-]}{[\text{HIn}]} \quad [\text{H}_3\text{O}^+] = K_a \frac{[\text{HIn}]}{[\text{In}^-]}$$

Intervalo de viraje para que sea visible al ojo humano:

Predominio del ácido

$$\frac{[\text{HIn}]}{[\text{In}^-]} \geq \frac{10}{1}$$

$$[\text{H}_3\text{O}^+] = 10K_a$$

Predominio de la base

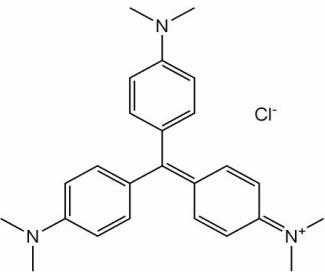
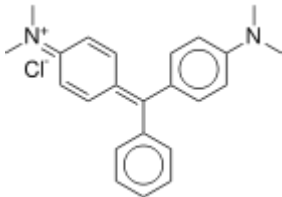
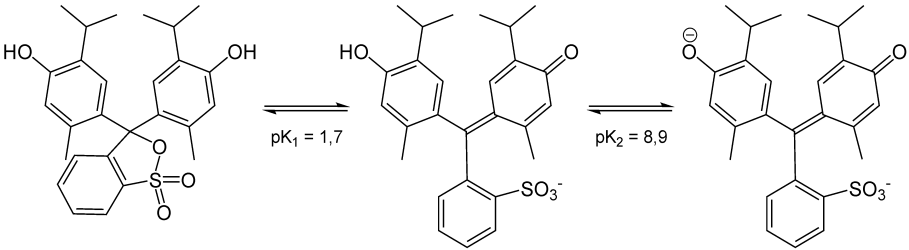
$$\frac{[\text{HIn}]}{[\text{In}^-]} \leq \frac{1}{10}$$

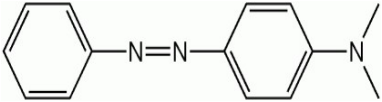
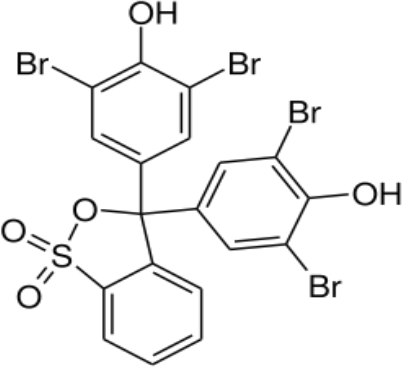
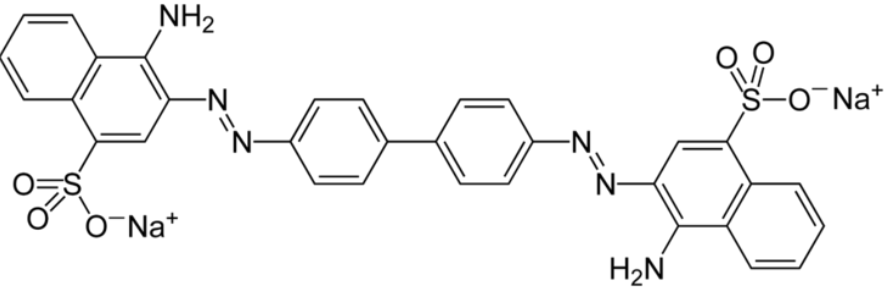
$$[\text{H}_3\text{O}^+] = 0.1K_a$$

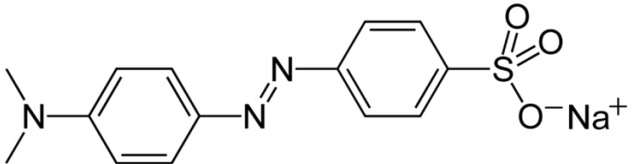

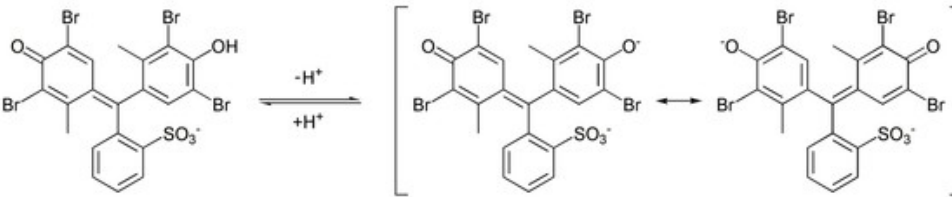
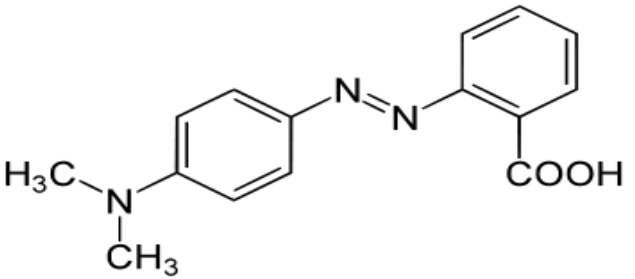
$$\text{pH}(\text{acid color}) = -\log(10K_a) = \text{p}K_a + 1$$

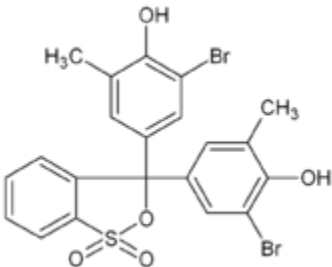
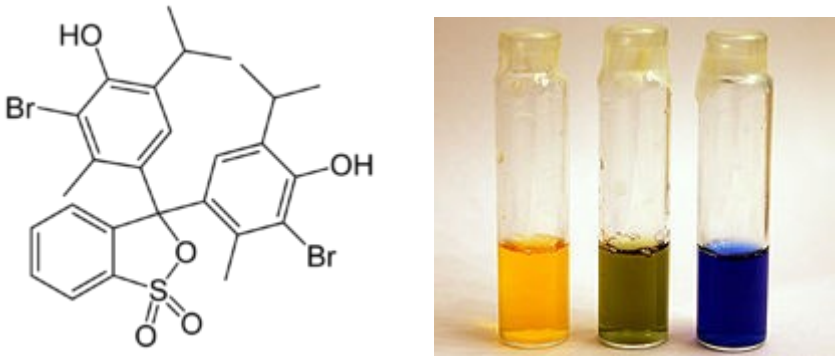
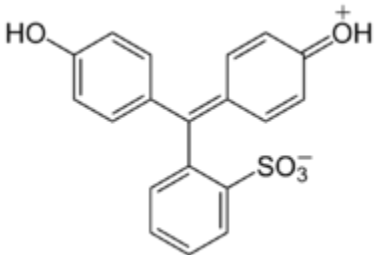
$$\text{pH}(\text{basic color}) = -\log(0.1K_a) = \text{p}K_a - 1$$

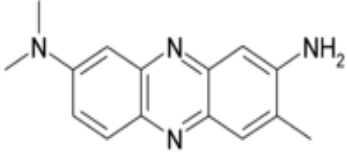
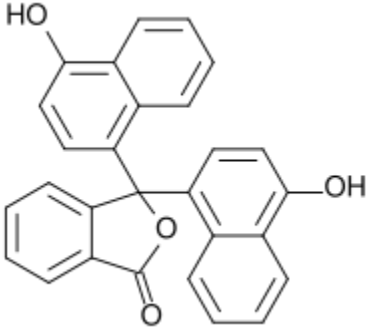
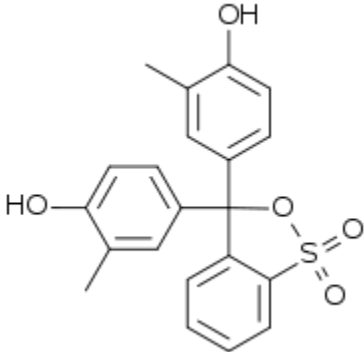
$$\text{indicator pH range} = \text{p}K_a \pm 1$$

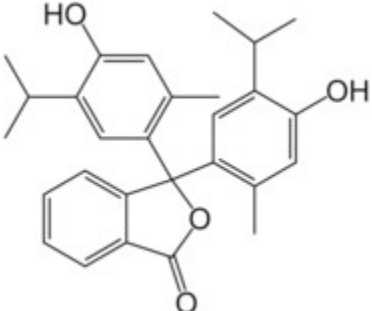
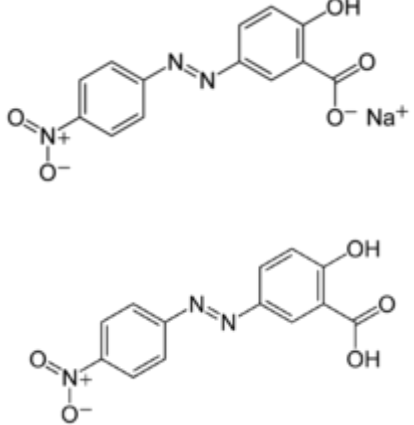
Indicador	Color a pH bajo	Intervalo de transición de pH	Color a pH alto
<p><u>Violeta de Genciana (Metil violeta)</u></p> 	Amarillo	0.0–2.0	Azul-violeta
<p><u>Verde de Leucomalaquita (Primera transición)</u></p> 	Amarillo	0.0–2.0	Verde
<p><u>Verde de Leucomalaquita (Segunda transición)</u></p>	Verde	11.6–14	Incoloro
<p><u>Azul de Timol (Primera transición)</u></p> 	Rojo	1.2–2.8	Amarillo
<p><u>Azul de Timol (Segunda transición)</u></p>	Amarillo	8.0–9.6	Azul

<p style="text-align: center;"><u>Amarillo de metilo</u></p> 	Rojo	2.9–4.0	Amarillo
<p style="text-align: center;"><u>Azul de bromofenol</u></p> 	Amarillo	3.0–4.6	Purpura
<p style="text-align: center;"><u>Rojo del Congo</u></p> 	Azul-violeta	3.0–5.0	Rojo

<p style="text-align: center;"><u>Naranja de Metilo</u></p> <div style="text-align: center;">  </div> <div style="text-align: center;">  </div>	Rojo	3.1–4.4	Naranja
<p style="text-align: center;"><u>Verde de Bromocresol</u></p> <div style="text-align: center;">  </div>	Amarillo	3.8–5.4	Azul-verdoso
<p style="text-align: center;"><u>Rojo de Metilo</u></p> <div style="text-align: center;">  </div>	Rojo	4.4–6.2	Amarillo
<u>Rojo de Metilo / Verde de Bromocresol</u>	Rojo	4.5–5.2	Verde

<p style="text-align: center;"><u>Azolitmina</u></p>	Rojo	4.5–8.3	Azul
<p style="text-align: center;"><u>Purpura de Bromocresol</u></p>  <p>The structure shows a central carbon atom bonded to a phenyl ring with a sulfonate group (-SO<sub>3</sub><sup>-</sup>), a 2,4,6-tribromophenyl ring, and two 3,5-dimethyl-4-hydroxyphenyl rings.</p>	Amarillo	5.2–6.8	Purpura
<p style="text-align: center;"><u>Azul de Bromotimol</u></p>  <p>The structure shows a central carbon atom bonded to a phenyl ring with a sulfonate group (-SO<sub>3</sub><sup>-</sup>), a 2,4,6-tribromophenyl ring, and two 2,4,6-trimethyl-5-hydroxyphenyl rings. To the right, three test tubes show the color change from yellow to green to blue.</p>	Amarillo	6.0–7.6	Azul
<p style="text-align: center;"><u>Rojo Fenol</u></p>  <p>The structure shows a central carbon atom bonded to a phenyl ring with a sulfonate group (-SO<sub>3</sub><sup>-</sup>), a 2,4,6-trihydroxyphenyl ring, and a 4-hydroxyphenyl ring.</p> <p style="text-align: center;">zwitterion: <math>\text{H}_2^+\text{PS}^- \rightarrow \text{HPS}^-</math></p>	Amarillo	6.8–8.4	Rojo

<p style="text-align: center;"><u>Rojo Neutro</u></p> 	Rojo	6.8–8.0	Amarillo
<p style="text-align: center;"><u>Naftolftaleína</u></p> 	Incoloro a rojizo	7.3–8.7	Verde azulado
<p style="text-align: center;"><u>Rojo Cresol</u></p> 	Amarillo	7.2–8.8	Purpura rojizo

<p style="text-align: center;"><u>Fenolftaleína</u></p>	<p style="text-align: center;">Incoloro</p>	<p style="text-align: center;">8.3–10.0</p>	<p>Violeta</p>
<p style="text-align: center;"><u>Timolftaleína</u></p>  <p>The structure shows a central carbon atom bonded to a lactone ring and three phenolic rings. Two of the phenolic rings are substituted with isopropyl groups and hydroxyl groups.</p>	<p style="text-align: center;">Incoloro</p>	<p style="text-align: center;">9.3–10.5</p>	<p>Azul</p>
<p style="text-align: center;"><u>Amarillo Alizarina R</u></p>  <p>Two chemical structures are shown. The top one is the sodium salt form, featuring a central azo group (-N=N-) connecting a 4-nitrophenyl ring to a 2-hydroxy-5-sulfonatephenyl ring. The bottom structure is the acid form, where the sulfonate group is replaced by a carboxylic acid group (-COOH).</p>	<p>Amarillo</p>	<p style="text-align: center;">10.2–12.0</p>	<p>Rojo</p>

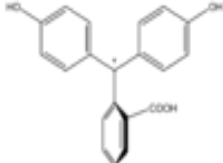
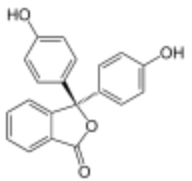
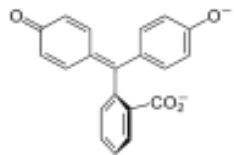
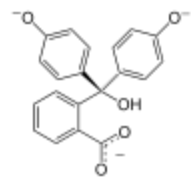
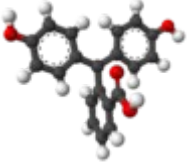
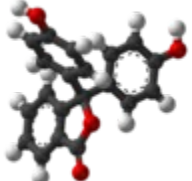
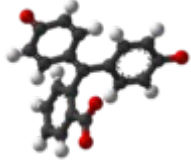
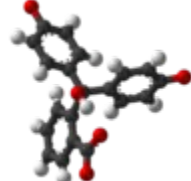




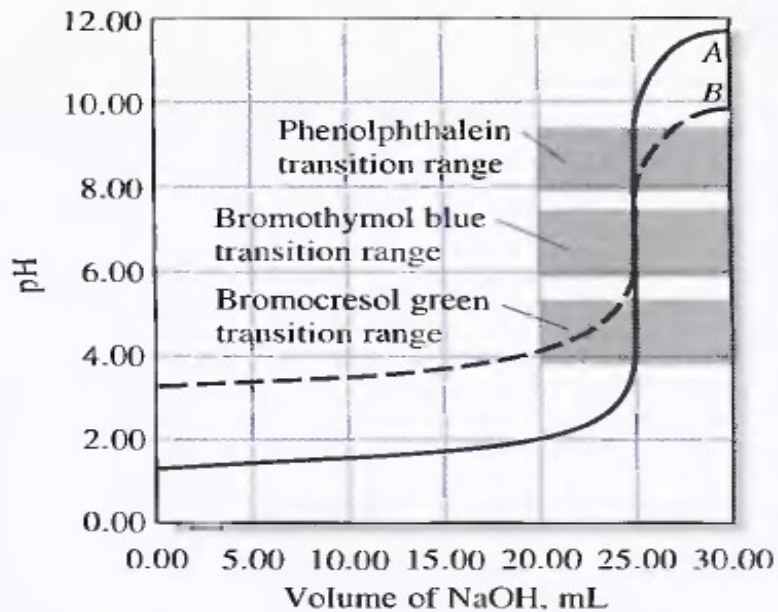
Fenolftaleína

Incoloro

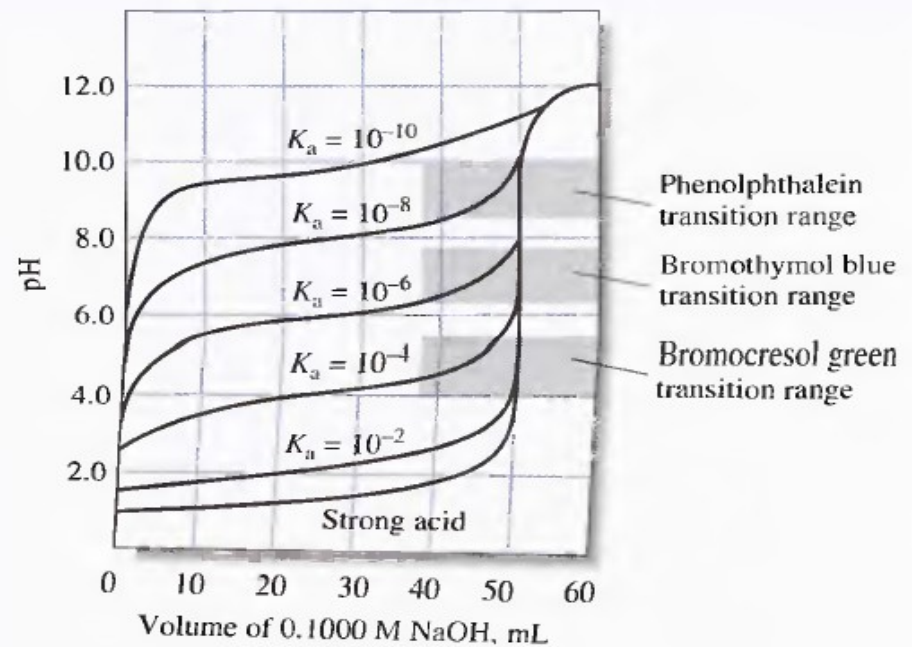
8.3–10.0

Violeta

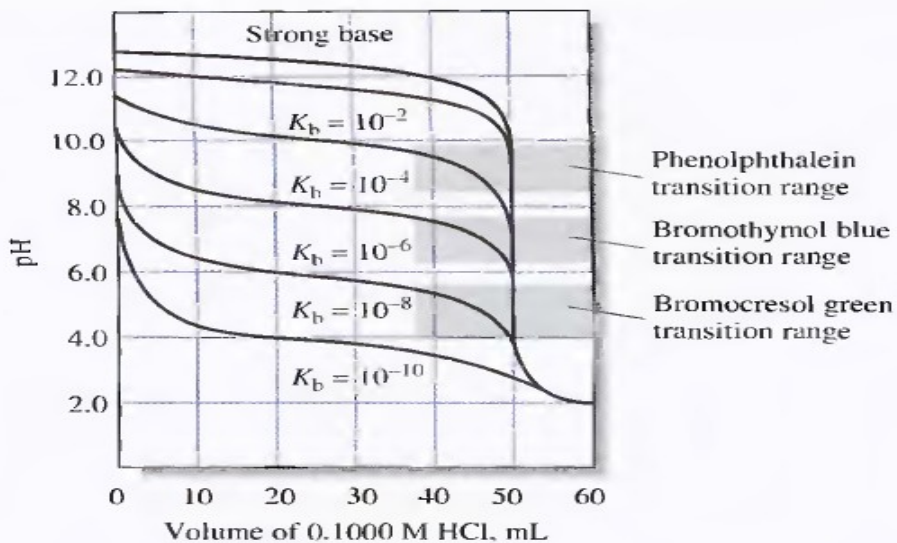
Especie	In	H <sub>2</sub> In	In <sup>2-</sup>	In(OH) <sup>3-</sup>
Estructura				
Modelo				
pH	< 0	0–8.2	8.2–12.0	>12.0
Condiciones	Muy acido	Poco acido-casi neutro	basico	Muy basico
Color	Naranja	Incoloro	<u>Rosa-violeta</u>	Incoloro
Imagen				



Titration curves for HCl with NaOH. Curve A: 50.00 mL of 0.0500 M HCl with 0.1000 M NaOH. Curve B: 50.00 mL of 0.000500 M HCl with 0.001000 M NaOH.



The effect of acid strength (dissociation constant) on titration curve. Each curve represents the titration of 50.00 mL of 0.1000 M acid with 0.1000 M base.



The effect of base strength ( $K_b$ ) on titration curves. Each curve represents the titration of 50.00 mL of 0.1000 M base with 0.1000 M HCl.

