South Pasadena • AP Chemistry

Name _____
Period ___ Date ___/___/___

17 • Acids & Bases

ACID-BASE TUTORIALS-1

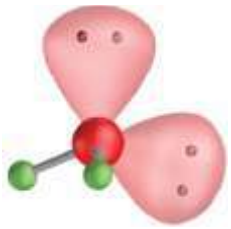
Self-Ionization of Water

This tutorial illustrates the process by which water molecules act as both a proton acceptor (base) and a proton donor (acid), and explores the equilibrium constant (K_w) for the self-ionization of water.

Section 1 of 7 – Introduction

The initial animation is the key idea in the tutorial.
Press Replay if you need to see it again.

Another name for self-ionization of water is _____-ionization of water.



Draw the Lewis electron-dot structure for H_2O.

What do the pink clouds represent? _____

An H^+ (a proton) moves from one H_2O to the other.
When H_2O ***gains*** an H^+, it becomes _____.
When H_2O ***loses*** an H^+, is becomes _____.

Section 2 of 7 – Molecular View

According to the Brønsted-Lowry definition,
an acid is a proton _____ and
a base is a proton _____.
A substance that can accept OR donate protons is said to be _____.

After a water donates an H^+, its formula is _____.
After a water accepts an H^+, its formula is _____.
The equation for this process would be:
$H_2O(l)$ + $H_2O(l)$ ⇆ _____(aq) + _____(aq)

Section 3 of 7 – Molecular View

Watch the animation. Is this equilibrium *reactant-favored* or *product-favored*?

_____

Section 4 of 7 – The Water Ionization Constant

Box the equation below that better illustrates the equilibrium between H_2O and its ions.

$$2\ H_2O(l) \leftrightarrows H_3O^+(aq) + OH^-(aq)$$

$$2\ H_2O(l) \leftrightarrows H_3O^+(aq) + OH^-(aq)$$

Copy the equilibrium constant expression, K_w.

The value of K_w at 25°C is _____.

At a higher temperature, do you think you will get more ions or fewer ions? _____

The value of K_w at 37°C would be _____ (higher / lower) than 1×10^{-14}?

[Note: according to www.acidbase.org, the value of K_w at 37 °C is 2.4×10^{-14}]

To calculate one ion's concentration from the other you could rewrite the K_w equation as:

$[OH^-]$ = _____

$[H_3O^+]$ = _____

Q1) $[OH^-]$ = _____ =

Q2) $[H_3O^+]$ = _____ =

Section 7 of 7 – Conclusion

The **Concept Question** misuses a word. What is it?

Can you answer the question? (It's important.)

Acid-Base Ionization

This tutorial explores the differences among Brønsted-Lowry acids, Brønsted-Lowry bases, Lewis acids and Lewis Bases.

Section 1 of 12 – Introduction

What acid is shown? _____

This substance is _____ (ionic / molecular).

After the H_2O enters and becomes H_3O^+, the acid is labeled incorrectly. The correct label is _____.

Section 2 of 12 – Acid Ionization

Finish the equation below with a single arrow (→) or double arrow (⇆) based on the animation.

$$HCl + H_2O \quad H_3O^+ + Cl^-$$

Section 3 of 12 – Acid Ionization

There is another mistake. Correct it in the excerpt below after watching the animation:

"The hydrogen ion is attracted to the partial positive charge on the oxygen atom of water. Since the hydrogen ion has no electrons, it forms a bond with one of the lone pairs of electrons on the oxygen atom of water, forming H_3O^+."

Section 4 of 12 – Base Ionization

Finish the equation below with a single arrow (→) or double arrow (⇆) based on the animation.

$$NH_3 + H_2O \quad NH_4^+ + OH^-$$

Section 5 of 12 – The Amphoteric Nature of Water

Circle the correct terms in the bottom two rows.

OH^-	H_2O	H_3O^+
	↵	↳
donates H^+ / accepts H^+		donates H^+ / accepts H^+
acid / base		acid / base

Section 6 of 12 – Lewis Acids and Bases

Summarize these definitions:

Brønsted-Lowry Acid	donates	
Brønsted-Lowry Base	accepts	
Lewis Acid	accepts	
Lewis Base	donates	

Label the H^+ and H_2O as Lewis acid & Lewis base:

$$H^+ + H_2O \rightarrow H_3O^+$$

_____ _____

Label the NH_3 and BF_3 as Lewis acid and base:

$$NH_3 + BF_3 \rightarrow NH_3BF_3$$

_____ _____

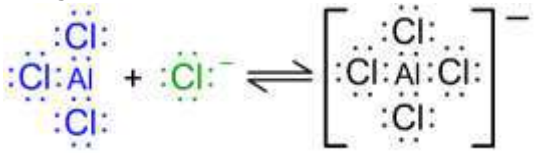
Q1) $H^- + H_2O \leftrightarrows H_2 + OH^-$

Q2) $CH_3COOH + H_2O \leftrightarrows CH_3COO^- + H_3O^+$

Q3) $CH_3COO^- + H_3O^+ \leftrightarrows CH_3COOH + H_2O$

Q4) Water can never act as an acid or a base.
True or False: _____

Q5) $AlCl_3 + Cl^- \leftrightarrows AlCl_4^-$



Notice that $AlCl_4^-$ is a "complex ion".
The central atom is always a Lewis _____.
The "ligands" are always Lewis _____.

Section 12 of 12 – Conclusion

Lewis acids are named after:

_____ ___ _____

Lewis acids concern the acceptance or donation of _____ _____.

Lewis dot symbols use "dots" to represent _____.

Brønsted-Lowry acids and bases deal with H^+ ions also called _____.