Chem 20 Unit C - Solutions, Acids and Bases

Ion Concentration

Nov 1-7:11 AM

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Proudly Presents:

The Periodic Table Movie of the Day!!!

Oct 26-2:11 PM

POS Checklist

- ☐ use data and ionization/dissociation equations to calculate the concentration of ions in a solution.

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Review:

Describe mass needed to produce 250 mL of a 2.5 mol/L concentration of copper (II) phosphate solution from its powdered reagent form.

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Review:

What volume of a 0.320 M $Na_2CO_{3(aq)}$ solution can be prepared from 16.4 g of $Na_2CO_{3(s)}$?

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Ion Concentrations

When in solution, ionic compounds form charged particles called ions. So far, we have calculated the concentration of the solution itself: today we will calculate the concentration of the individual ions.

Recall how ionic compounds form ions: through dissociation.

ex) Write a balanced dissociation reaction for magnesium chloride.

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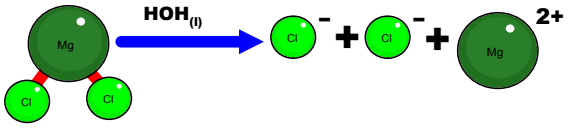
This dissociation could be visualized as follows:



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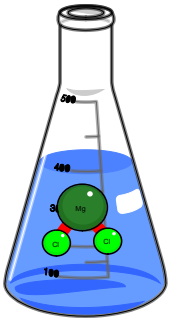
Now, let's talk concentration. Assume that we place this one particle of $MgCl_{2(aq)}$ into one litre of water.



We would say that the concentration of $MgCl_{2(aq)}$ in the beaker is 1 particle/ L.

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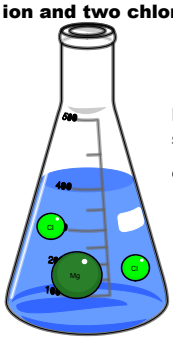
Now, let's think about what would happen once the particle dissociated. We now have one magnesium ion and two chlorine ions.



Now, the concentration of $Mg^{2+}_{(aq)}$ is still 1 particle/L, but the concentration of $Cl^{-}_{(aq)}$ is 2 particles/L.

Charges left out for simplicity.

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Notice how we can derive this relationship from the initial balanced equation.

$$1\ MgCl_{2\,(s)} \longrightarrow 1\ Mg^{2+}_{(aq)} + 2Cl^{-}_{(aq)}$$

If the concentration of $MgCl_{2(s)}$, once placed in solution, is 1 mol/L...

the concentration of $Mg^{2+}_{(aq)}$ is 1 mol/L...

and the concentration of $Cl^{-}_{(aq)}$ is 2 mol/L.

The concentration of chloride ions is twice as much because there are twice as many ions present (we just multiply the initial concentration by the coefficient of 2).

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ex) Find the amount concentration of each ion in the following solutions:

a) 0.41 mol/L $Na_2S_{(aq)}$

b) 1.2 mol/L $Sr(NO_3)_{2(aq)}$

c) 0.13 mol/L $(NH_4)_3PO_{4(aq)}$

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Uses of Ion Concentration

One important use for ion concentration is in measuring the amount of hydrogen ions present in acidic solutions.

Recall that in the late 19th century, Swedish chemist Svante Arrhenius proposed that any ionic compound which dissolves into hydrogen ions will act as an acid.

He is the one who said "All acids contain hydrogen" (not completely correct, but we'll accept it for right now).

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The higher the concentration of the hydrogen ions in solution, the stronger the acid will be.

Acidic solutions have a $[H^+_{(aq)}] > 1 \times 10^{-7}$ mol/L
Neutral solutions have a $[H^+_{(aq)}] = 1 \times 10^{-7}$ mol/L
Basic solutions have a $[H^+_{(aq)}] < 1 \times 10^{-7}$ mol/L

Thus, a solution with a $[H^+_{(aq)}] = 1 \times 10^{-9}$ mol/L would be basic.

A solution with $[H^+_{(aq)}] = 1 \times 10^{-4}$ mol/L would be acidic.

Notice anything familiar?

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These numbers kind of correspond to the pH scale used for describing acids and bases.

pH = power of hydrogen

The concept of the pH scale was developed by Soren Sorensen in 1909. It is still used today to communicate acidity.

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If we take the negative logarithm of these concentrations, we can come up with positive interger numbers which can be used to communicate concentration of hydrogen. These numbers are called pH values.

Base: $[H^+_{(aq)}] = 1 \times 10^{-9}$ mol/L = $-\log(1 \times 10^{-9})$ =
Acid: $[H^+_{(aq)}] = 1 \times 10^{-4}$ mol/L = $-\log(1 \times 10^{-4})$ =

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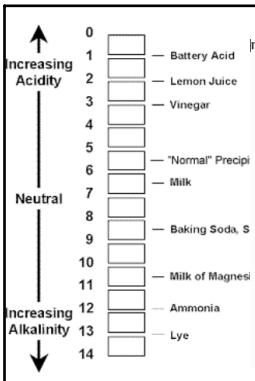

Table 1. Correlation of pH values and Hydronium ion concentrations

pH	Hydronium ion concentration (moles/L)	
1	.1	(1×10^{-1})
2	.01	(1×10^{-2})
3	.001	(1×10^{-3})
4	.0001	(1×10^{-4})
5	.00001	(1×10^{-5})
6	.000001	(1×10^{-6})
7	.0000001	(1×10^{-7})
8	.00000001	(1×10^{-8})
9	.000000001	(1×10^{-9})
10	.0000000001	(1×10^{-10})
11	.00000000001	(1×10^{-11})
12	.000000000001	(1×10^{-12})
13	.0000000000001	(1×10^{-13})
14	.00000000000001	(1×10^{-14})

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Practice: Page 212 #18 and 19

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