Lab Work #1

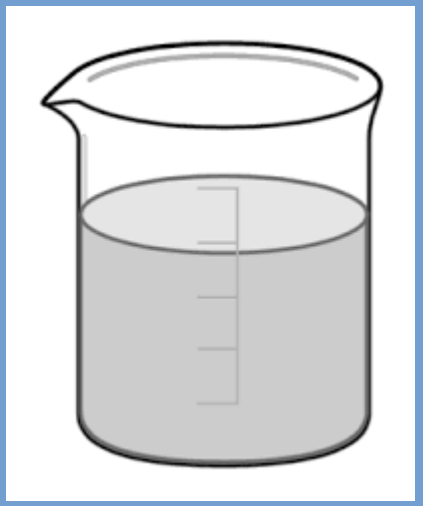
Some experiments with acids and bases

pH meter

☞ ***Calibrate the pH meter***

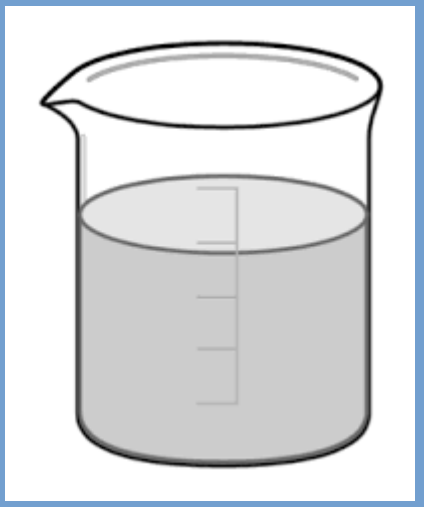
I. Aqueous acidic solutions

Experiment #1 : how can we prove that ethanoic acid reacts with water ?



Water (about 30 mL)

pH = ...



Water (about 30 mL)

and few drops of pure ethanoic acid

pH = ...

Explain why these measurements prove that a chemical reaction occurred.

Course

By definition : **$pH = -\log[H_3O^+]$** , or **$[H_3O^+] = 10^{-pH}$**

- Calculate the concentration of oxonium ions $[H_3O^+]$ before and after you add ethanoic acid.

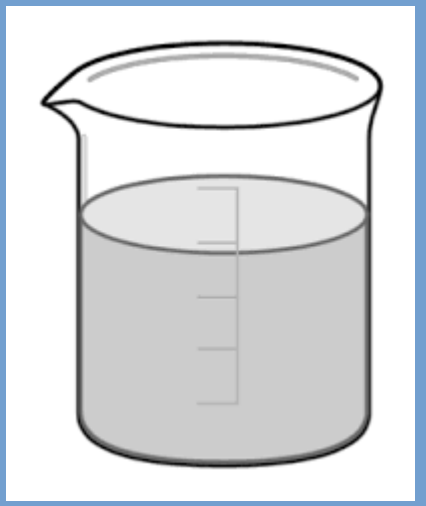
- The reaction between ethanoic acid and water is immediate (or instantaneous); its equation is:

$$CH_3COOH(l) + H_2O(l) \rightleftharpoons CH_3COO^-(aq) + H_3O^+(aq)$$

Explain why this equation accords with your experimental results.

Experiment #2 : reaction between ethanoic acid and water

An aqueous solution of ethanoic acid (concentration: $C = 1{,}0 \times 10^{-2}$ mol.L^{-1})
It was prepared by dissolving pure ethanoic acid into water



20 mL of the solution of ethanoic acid

pH = …….

Keep this beaker for part II experiments

limiting reactant

Equation	$CH_3COOH(l)$	+ $H_2O(l)$	$\rightleftharpoons$	$CH_3COO^-(aq)$	+ $H_3O^+(aq)$
	Quantities (in mol)				
Initial (x=0)	C.V	excess			
During the reaction					
At the maximum extent ($x=x_{max}$)		excess			
At the real final extent ($x=x_f$)		excess			

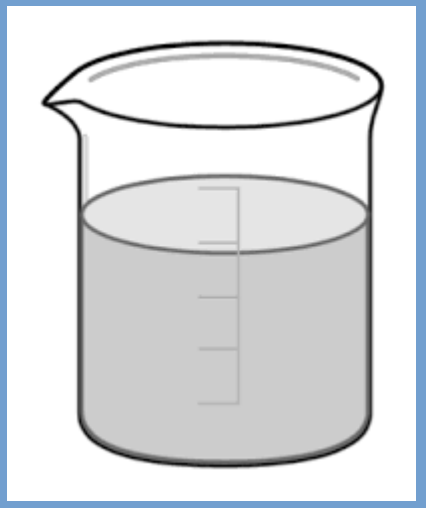
Compare x_f et x_{max}. Is the reaction between ethanoic acid and water complete (total) or limited?

Experiment #3 : reaction between hydrogen chloride and water

An aqueous solution of hydrochloric acid

(concentration:C = $1{,}0 \times 10^{-2}$ mol.L^{-1});

it was prepared by dissolving hydrogen chloride (HCl) into water.



20 mL of the solution of hydrochloric acid

pH = ...

limiting reactant

Equation	$HCl(g)$	$+ H_2O(l)$	$\rightleftharpoons$	$Cl^-(aq)$	$+ H_3O^+(aq)$
	Quantities (in mol)				
Initial (x=0)	C.V	excess			
During the reaction					
At the maximum extent ($x=x_{max}$)		excess			
At the real final extent ($x=x_f$)		excess			

Compare x_f et x_{max}. Is the reaction between HCl and water complete (total) or limited?

Course (conclusion of exp#2 and 3)

HCl(g) is a “strong acid”:

it means that its reaction with water is .....

So : $[H_3O^+]$ C

$CH_3COOH(l)$ in a “weak acid”.

it means that its reaction with water is .....

So : $[H_3O^+]$ C

II. Chemical equilibrium

Course

As the reaction between ethanoic acid and water is limited, the chemical system reaches an equilibrium state.

In the final state, all the reactants and products of the reaction exist together.

$$CH_3COOH(l) + H_2O(l) \rightleftharpoons CH_3COO^-(aq) + H_3O^+(aq)$$

Beaker #1

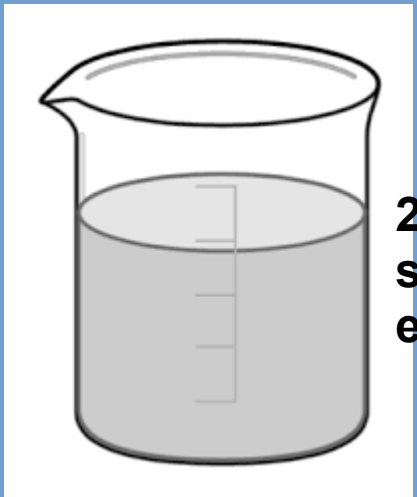
20 mL of the solution of ethanoic acid

Carefully, add few drops of pure ethanoic acid

pH = ...

pH = ...

Beaker #2



20 mL of the solution of ethanoic acid

Add half a spatula of ethanoate ion (CH_3COO^-), mix to dissolve

pH = ...

pH = ...

Course

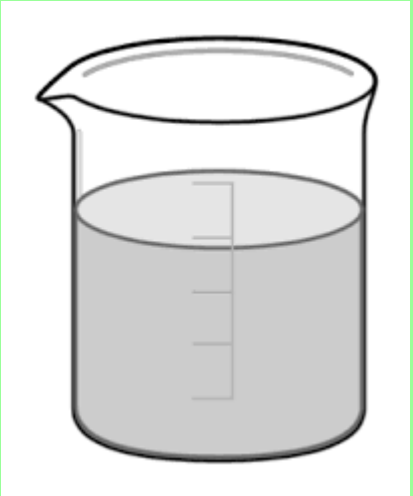
The chemical equilibrium can be moved:

- If we add a reactant, the equilibrium is moved to the right.
- If we add a product, it is moved to the left.

III. Thermic effect of a reaction between an acid and a base

Beaker #1

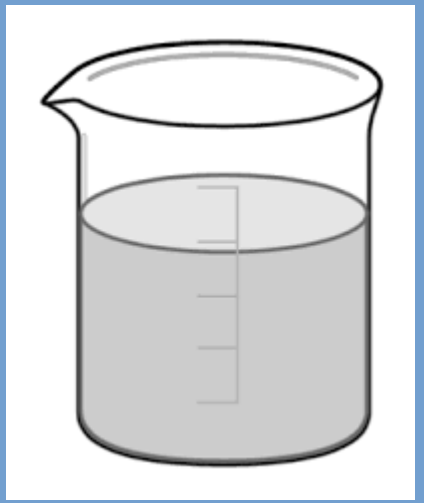
20 mL of the solution of hydrochloric acid C = 1,0 mol/L



Temperature : T = ……

Beaker #2

20 mL of the solution of sodium hydroxide (base) C = 1,0 mol/L



Temperature : T = ……

Carefully, pour beaker 1 into beaker 2 ; and measure the temperature.

Is the reaction endothermic, athermic or exothermic ?

Which experiment could we do to show the effect of the concentration on the increase of temperature ?

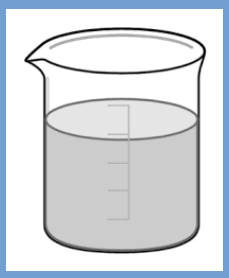

Lab Work #1
Some experiments
with acids and bases

pH meter

☞ ***Calibrate the pH meter***

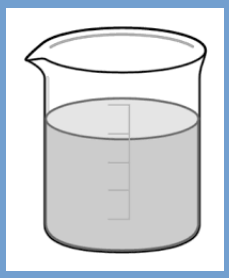
I. Aqueous acidic solutions

Experiment #1 : how can we prove that ethanoic acid reacts with water ?



Water (about 30 mL)

pH = ...



Water (about 30 mL) and few drops of pure ethanoic acid

pH = ...

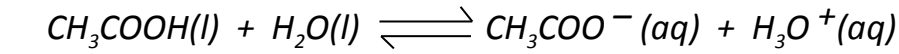
Explain why these measurements prove that a chemical reaction occurred.

Course

By definition : **pH = - log[H_3O^+]** , or **[H_3O^+] = 10^{-pH}**

- Calculate the concentration of oxonium ions [H_3O^+] before and after you add ethanoic acid.

- The reaction between ethanoic acid and water is immediate (or instantaneous); its equation is:

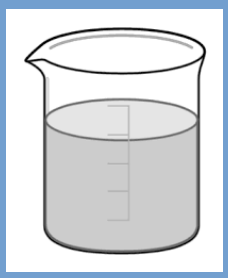


$$CH_3COOH(l) + H_2O(l) \rightleftharpoons CH_3COO^-(aq) + H_3O^+(aq)$$

Explain why this equation accords with your experimental results.

Experiment #2 : reaction between ethanoic acid and water

An aqueous solution of ethanoic acid (concentration: C = $1{,}0 \times 10^{-2}$ mol.L^{-1})
It was prepared by dissolving pure ethanoic acid into water



20 mL of the solution of ethanoic acid

pH = …….

Keep this beaker for part II experiments

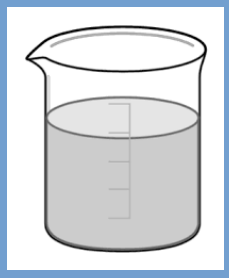
limiting reactant

Equation	$CH_3COOH(l)$	$+ H_2O(l)$	$\rightleftharpoons$ $CH_3COO^-(aq)$	$+ H_3O^+(aq)$
	Quantities (in mol)			
Initial (x=0)	C.V	excess		
During the reaction				
At the maximum extent ($x=x_{max}$)		excess		
At the real final extent ($x=x_f$)		excess		

Compare x_f et x_{max}. Is the reaction between ethanoic acid and water complete (total) or limited?

Experiment #3 : reaction between hydrogen chloride and water

An aqueous solution of hydrochloric acid
(concentration:C = $1{,}0 \times 10^{-2}$ mol.L^{-1});
it was prepared by dissolving hydrogen chloride (HCl) into water.



20 mL of the solution of hydrochloric acid

pH = ...

limiting reactant

Equation	$HCl(g)$	$+ H_2O(l)$	$\rightleftharpoons$	$Cl^-(aq)$	$+ H_3O^+(aq)$
	Quantities (in mol)				
Initial (x=0)	C.V	excess			
During the reaction					
At the maximum extent ($x=x_{max}$)		excess			
At the real final extent ($x=x_f$)		excess			

Compare x_f et x_{max}. Is the reaction between HCl and water complete (total) or limited?

Course (conclusion of exp#2 and 3)

HCl(g) is a “strong acid”:
it means that its reaction with water is .....
So : $[H_3O^+]$ C

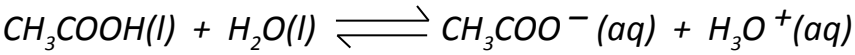
$CH_3COOH(l)$ in a “weak acid”.
it means that its reaction with water is .....
So : $[H_3O^+]$ C

II. Chemical equilibrium

Course

As the reaction between ethanoic acid and water is limited, the chemical system reaches an equilibrium state.

In the final state, all the reactants and products of the reaction exist together.



Beaker #1

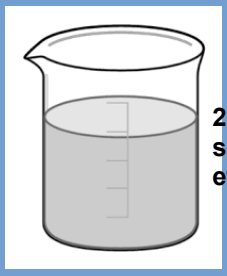
20 mL of the solution of ethanoic acid

pH = …….

Carefully, add few drops of pure ethanoic acid

pH = …….

Beaker #2



20 mL of the solution of ethanoic acid

pH = …….

Add half a spatula of ethanoate ion (CH_3COO^-), mix to dissolve

pH = …….

Course

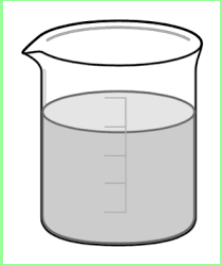
The chemical equilibrium can be moved:

- If we add a reactant, the equilibrium is moved to the right.
- If we add a product, it is moved to the left.

III. Thermic effect of a reaction between an acid and a base

Beaker #1

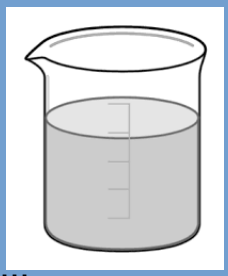
20 mL of the solution of hydrochloric acid C = 1,0 mol/L



Temperature : T = ……

Beaker #2

20 mL of the solution of sodium hydroxide (base) C = 1,0 mol/L



Temperature : T = ……

Carefully, pour beaker 1 into beaker 2 ; and measure the temperature.

Is the reaction endothermic, athermic or exothermic ?

Which experiment could we do to show the effect of the concentration on the increase of temperature ?