Sequence 2: acid-base reactions in aqueous solutions

Fiche de synthèse mobilisée (collection en français) :

- Fiche n°2 : réactions acide-base en solution aqueuse

Sommaire des activités ETLV :

ACTIVITY 1: Percent dissociation of an acid

Objective: understanding percent dissociation

DOCUMENT 1: Percent dissociation

Percent dissociation is symbolized as α (alpha) and represents the ratio of the final concentration of base $[A^-]_f$ (after dissociation) to the initial concentration of the acid $[HA]$ = C_a.

Dilute acids dissociate more than concentrated ones. Percent dissociation can be easily calculated if the pH of the solution and the pKa of the acid are known:

$$\alpha = \frac{[A^-]_f}{C_a}$$

Acquiring vocabulary:

Find a translation for the following expressions:

English	French
strong acid	
weak acid	
percent dissociation	
dilute acids	
conjugate base	
ratio	

■ **Applying:**

A weak acid, HA, has a pKa of 4.76. If the solution pH is 3.85, what percentage of the acid is dissociated?

_____
_____
_____
_____

ACTIVITY 2: Influence of dilution on percent dissociation of an acid

Objective: understanding the effect of dilution

DOCUMENT 1: Acetic acid equilibrium

Acetic acid is a weak acid that can dissociate in water as follows:

$$\mathrm{CH_3COOH_{(aq)} + H_2O_{(l)} \rightleftharpoons CH_3COO^-_{(aq)} + H_3O^+_{(aq)}}\,.$$

Its equilibrium constant can be defined as:

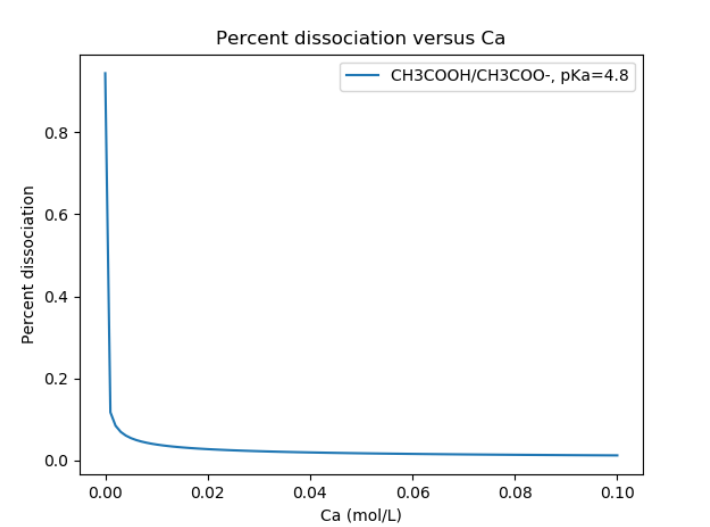
$$K_\mathrm{a} = \frac{[\mathrm{CH_3COO^-}]_\mathrm{eq}\ [\mathrm{H_3O^+}]_\mathrm{eq}}{[\mathrm{CH_3COOH}]_\mathrm{eq} c^\circ} = 10^{-4{,}8} \simeq 1 \cdot 10^{-5} \ll 1$$

Its percent dissociation constant can thus be defined as:

$\alpha = \frac{[CH_3COO^-]_{eq}}{C_a}$ with C_a the initial concentration of acid.

DOCUMENT 2: Influence of dilution

Using Python, one can compute α for different values of C_a. The results are plotted below:



■ **Applying:**

In your opinion, what seems to be the influence of dilution on percent dissociation?

_____
_____
_____
_____

ACTIVITY 3: Influence of pKa on percent dissociation

Objective: understanding the effect of pKa

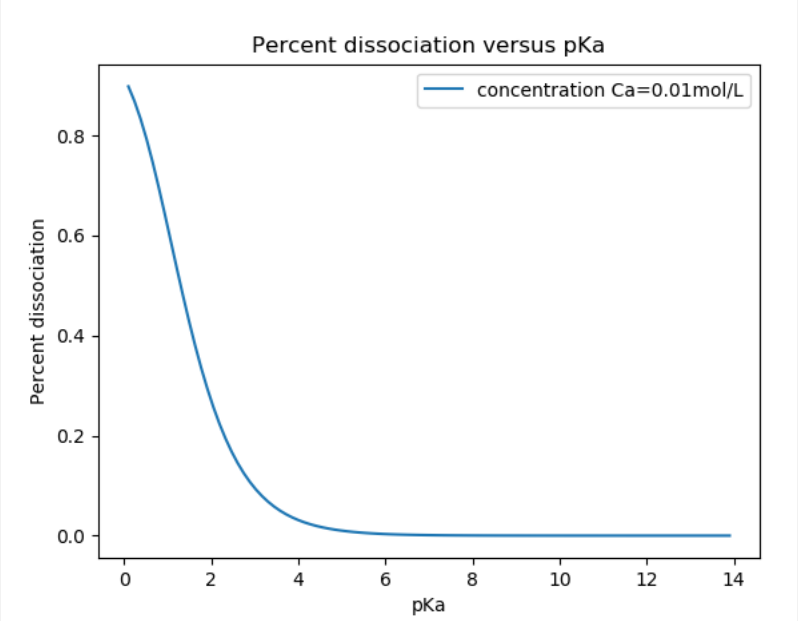
DOCUMENT 1: Acid-base equilibrium

Different acid-base couples are studied. For each acid, the percent dissociation constant can be defined as:

$$\alpha = \frac{[A^-]_{eq}}{C_a}$$ with C_a the initial concentration of acid.

DOCUMENT 2: Influence of pK_a

Using Python, one can compute α for different values of pK_a. The results are plotted below:



■ **Applying:**

In your opinion, what seems to be the influence of pK_a on percent dissociation?

_____
_____
_____
_____

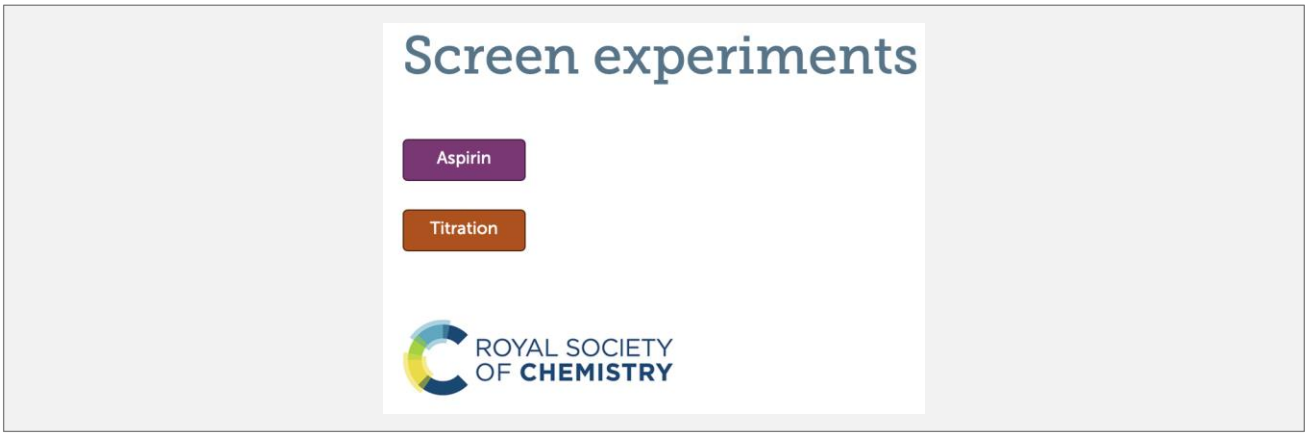
ACTIVITY 4: The contaminated stream

Objective: understanding acid-base titration

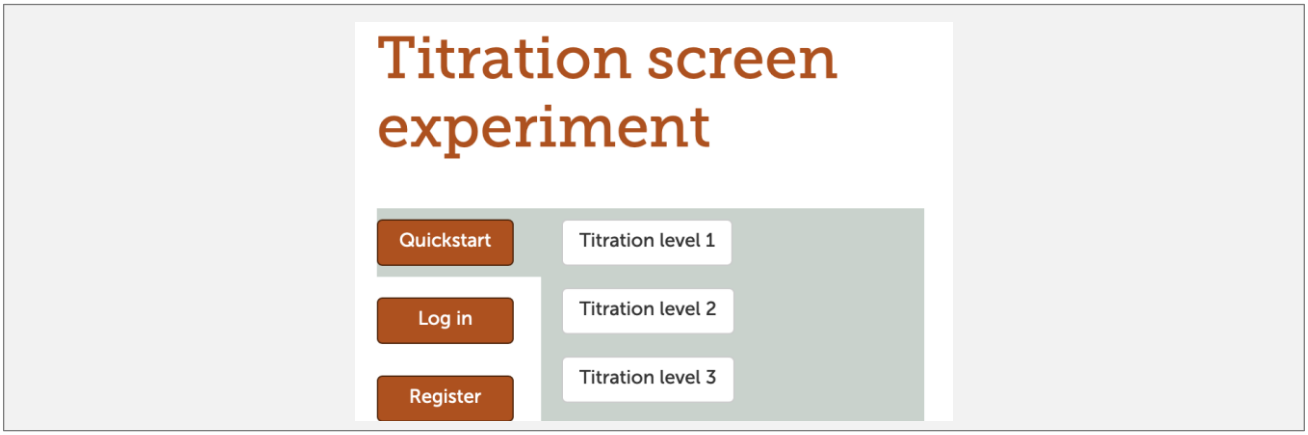
This virtual resource is a courtesy of Royal Society of Chemistry: https://virtual.edu.rsc.org

We recommend you start with titration level 1

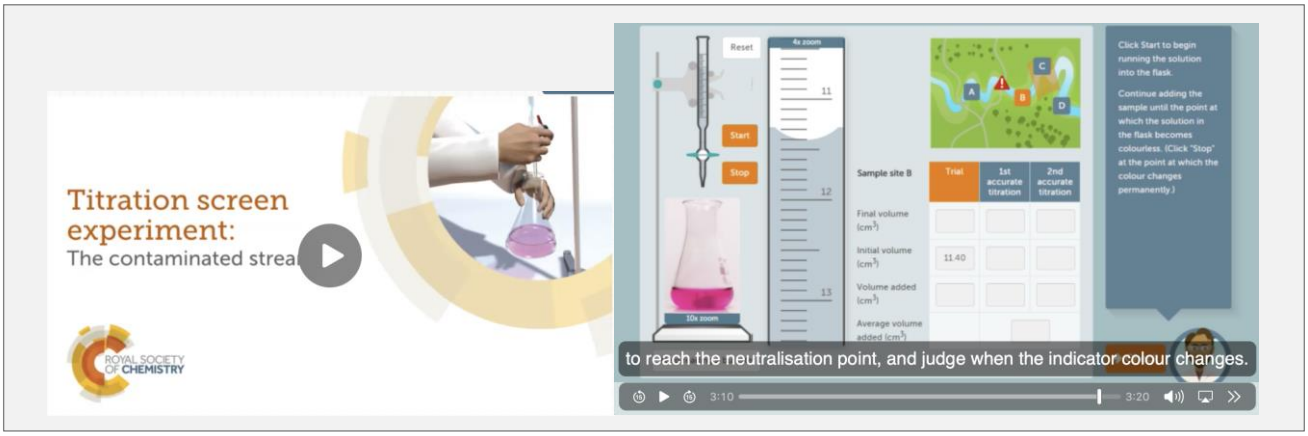
1) Select titration:



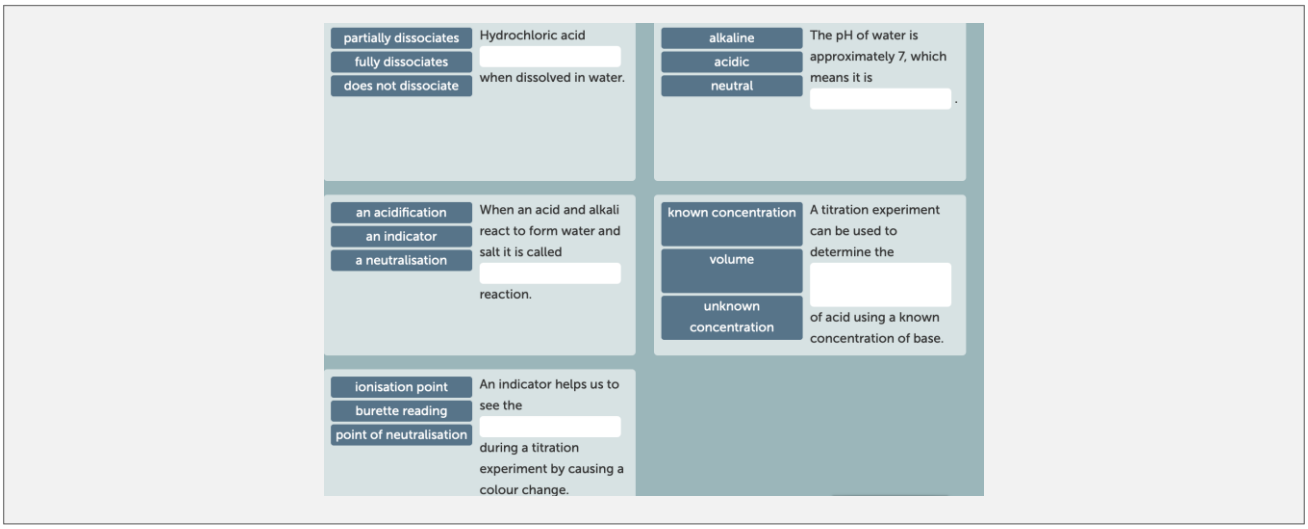
2) Select level 1:



3) Watch the video, then follow the instructions:



4) Take the comprehension test:



If you have succeeded, you can follow the instructions until the teacher tells you to stop.

Activity summary

What you must remember:
- weak acid, strong acid
- percent dissociation

Skills linked to the curriculum**:**

Compétences	Capacités à maîtriser	Où dans cette séquence ?
APP	Utiliser du vocabulaire spécifique	Activités 1 à 4
	Lire et comprendre des documents scientifiques	Activités 1 à 4
ANA	Mettre en lien des documents pour émettre des hypothèses en réponse à une question scientifique	Activités 2 et 3
COM	S'exprimer à l'écrit en utilisant le vocabulaire adapté	Activités 1 à 3
REA	• Utiliser la conservation de la matière pour déterminer le coefficient de dissociation d'un acide faible dans l'eau, connaissant l'état initial et le pH à l'équilibre • Prévoir qualitativement l'effet de la dilution sur le coefficient de dissociation d'un acide faible.	Activité 1 Activité 2