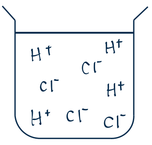
Strong and weak acids

1 Definitions

Strong acids

completely ionizes in water



所有 acid molecules 也成为了 mobile ions

$HA \rightarrow H^+ + A^-$

单向的 reaction ⇓ 只有 product

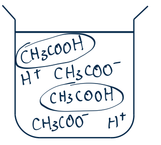
HCl, H_2SO_4, HNO_3

⇩ pH

(basicity 一样时, H^+ 更多)

Weak acids

does not completely ionizes in water



只有一部分 acid molecules 成为了 mobile ions

$HB \rightleftharpoons H^+ + B^-$

reversible reaction ⇓ 达至 equilibrium (reactant, product 都有)

所有其他 acid

⇧ pH

(basicity 一样时, H^+ 更少)

2 Differentiating strong and weak acids

- eg. HCl and CH_3COOH — basicity 与 concentration 须一样才能比较

PHYSICAL METHOD

a. pH value
- Prepare same volume of 0.1M $HCl_{(aq)}$ and 0.1M $CH_3COOH_{(aq)}$
- Using pH paper, measure the pH value of both solutions
- 0.1M HCl has a lower pH value than 0.1M $CH_3COOH_{(aq)}$.
- strong acids → $[H^+]$⇧ → pH ⇩

b. Electrical conductivity
- Prepare same volume of 0.1M $HCl_{(aq)}$ and 0.1M $CH_3COOH_{(aq)}$
- Using a light bulb, test the electrical conductivity of both solutions
- 0.1M $HCl_{(aq)}$ provides a brighter light bulb than 0.1M $CH_3COOH_{(aq)}$.
- strong acids → no# of mobile ions ⇧ → electrical conductivity⇧

CHEMICAL METHOD

a. Reaction rate
- React same mass of iron w/ same volume of excess 0.1M $HCl_{(aq)}$ and 0.1M $CH_3COOH_{(aq)}$
  ($Fe + 2H^+ \rightarrow Fe^{2+} + H_2$)
- 0.1M $HCl_{(aq)}$ gives bubbles at a faster rate.
- H^+ 浓度⇧ → 粒子碰撞频率⇧ → reaction rate⇧

☆ 最后 H_2 的 volume 还是一样的

1. limiting reactant 是铁
2. reaction 会发热 (exothermic)
   放出来的热会使 CH_3COOH 其他 molecules ionize (温度⇧, ionize 的 H^+⇧)
   最后所有 required 的 CH_3COOH (不包括 excess) 也会被 ionize 了
   可是因为热用来了 ionize, 达成 reaction 本身 activation energy 需时更久
   Reaction rate ⇩

3 Showing ... is strong / weak acids

Prepare 0.1M of the acid. → assume basicity = 1

Measure its pH accurately w/ pH meter.

$HX \rightarrow H^+ + X^-$ (1 : 1 : 1; 0.1M → 0.1M)

If acid is completely ionized, $pH = -\log[H^+] = -\log 0.1 = 1$

So, if pH = 1 → strong acid. If pH > 1 → weak acid