

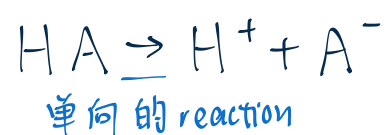
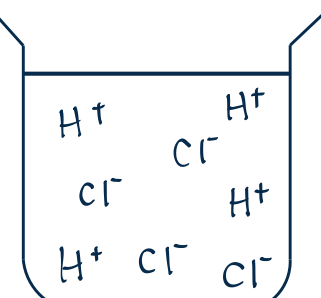
Attributes of acids affecting pH

1 Strong and weak acids

DEFINITION

Strong acids

completely ionizes in water



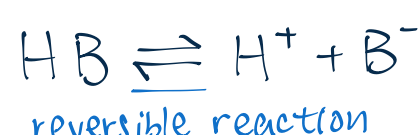
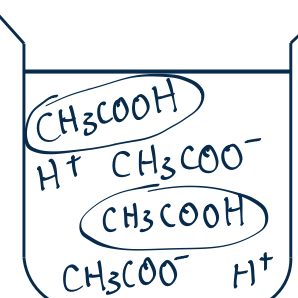
HCl, H₂SO₄, HNO₃

↓ pH

(basicity 一样时, H⁺ 更多)

Weak acids

does not completely ionizes in water



所有其他 acid

↑ pH

(basicity 一样时, H⁺ 更少)

DISTINGUISHING STRONG AND WEAK ACIDS

- eg. HCl and CH₃COOH - 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 CH₃COOH(aq)
- Using **pH paper**, measure the pH value of both solutions
- 0.1M HCl has a lower pH value than 0.1M CH₃COOH(aq).
- strong acids → [H⁺] ↑ → pH ↓

b. Electrical conductivity

- Prepare same volume of 0.1M HCl(aq) and 0.1M CH₃COOH(aq)
- Using a **light bulb**, test the electrical conductivity of both solutions
- 0.1M HCl(aq) provides a brighter light bulb than 0.1M CH₃COOH(aq).
- strong acids → no. of mobile ions ↑ → electrical conductivity ↑

CHEMICAL METHOD

a. Reaction rate

- React same mass of identical iron w/ same volume of excess 0.1M HCl(aq) and 0.1M CH₃COOH(aq) (Fe + 2H⁺ → Fe²⁺ + H₂)
→ METAL / METAL carbonate (带有气泡)
- 0.1M CH₃COOH(aq) gives bubbles at a slower rate.
- H⁺ 浓度 ↓ → 粒子碰撞频率 ↓ → reaction rate ↓
- reaction is exothermic, 放出来的热会使 CH₃COOH 其他 molecules ionize
→ 温度 ↑, ionize 的 H⁺ ↑
最后所有 required 的 CH₃COOH (不足够 excess) 也会被 ionize 了 → ∴ initial H₂ volume 一样
可是因为热用来 ionize, 达成 reaction 本身 activation energy 需时更久
Reaction rate ↓
- ★ 最后 H₂ 的 volume 还是一样的 (limiting reactant 是铁)

b. Reaction temperature rise

- 如上: react same mass of identical iron w/ same volume of excess 0.1M HCl(aq) & 0.1M CH₃COOH(aq).
→ base / metal (只有 exothermic 都行)
- Measure **highest temperature reached** by reaction mixture w/ thermometer.
- 0.1M CH₃COOH(aq) has lower highest temperature reached.
- 解释与上面一样 → ∴ 部分热用来 ionize CH₃COOH (ie break bonds)
整体温度上升 ↓

SHOWING ... IS STRONG/WEAK ACID

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

Measure its pH accurately w/ pH meter. $HX \rightarrow H^+ + X^-$
0.1M → 0.1M

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

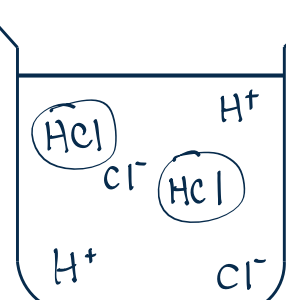
So, if pH = 1 → strong acid. If pH > 1 → weak acid

2 Concentrated and dilute acids

DEFINITION

Conc. acids

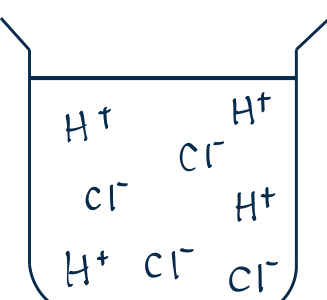
13 至 15 M



水不够, 不能 completely ionize

Dilute acids

零点几 - 1 M



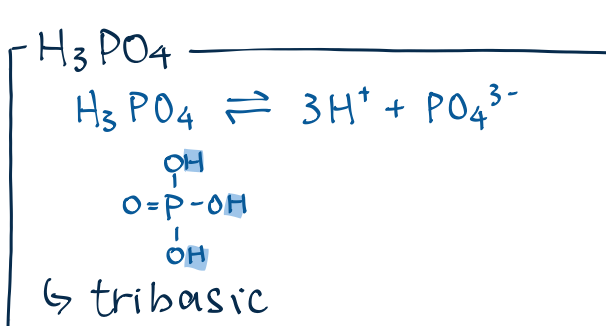
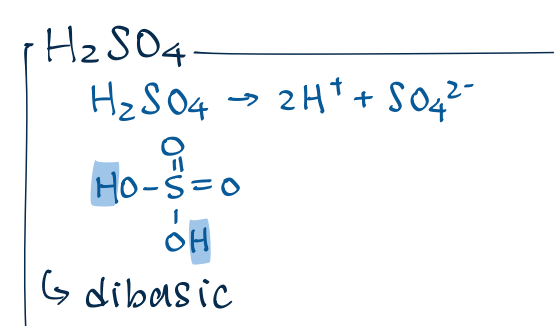
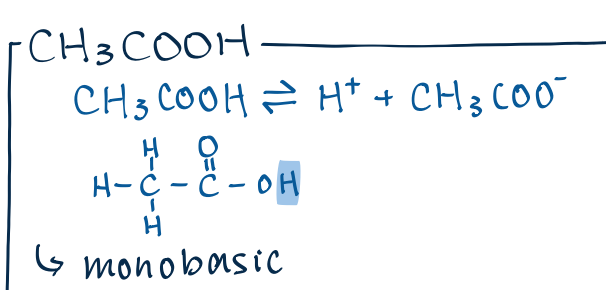
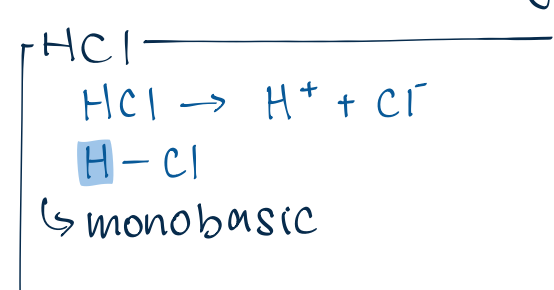
(HCl: strong acid)
completely ionize

→ May have different acid R.A.s reaction

3 Basicity

DEFINITION

- max. no of ionizable hydrogen atoms in an acid molecule



MOLE RATIO OF ACID-BASE REACTIONS

知识点

- 1. 1 acid 的 basicity 和 base anion 的 charge 判断 mole ratio

- 把两个数字调整, 再约简

→ HCl + NaOH, basicity = 1, anion charge = -1 → 1:1

→ H₂SO₄ + NaOH, basicity = 2, anion charge = -1 → 1:2

→ H₃PO₄ + Na₂CO₃, basicity = 3, anion charge = -2 → 2:3

2g dibasic acid requires 30cm³ of 2.15M NaOH for complete neutralisation.
Find its molar mass.

acid mole : NaOH mole = 1 : 2

n : 2.15 × 0.03 = 1 : 2

mole = molarity × volume n = 0.0325

$\frac{mass}{Mr} = mole$

$\frac{2}{Mr} = 0.0325$

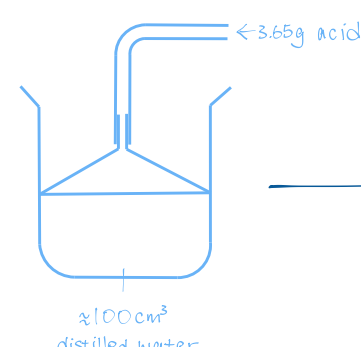
Mr = 62.0

3.65g acid in gas state w/ Mr 36.5 is dissolved completely into 100cm³ distilled water.

The sol. is poured into 250cm³ volumetric flask for dilution.

25cm³ of the sol. is pipetted out to a conical flask and titrated against 0.1M NaOH

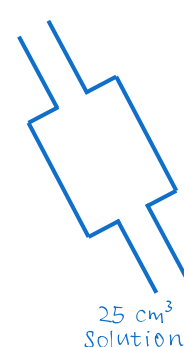
If 100cm³ of 0.1M NaOH is needed for complete neutralisation, find the basicity of the acid.



$\frac{3.65}{36.5} = 0.1 \text{ mol}$

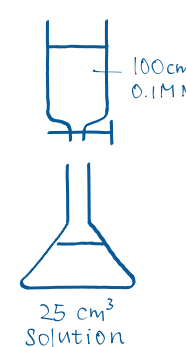
0.1 mol

(加水稀释)



0.01 mol

(独立溶 sol, mol 数至原溶液)



0.01 mol

0.1M NaOH

0.1M NaOH

mole of acid : mole of alkali

= 0.01 : 0.01

= 1 : 1

∴ monobasic

4 Mixed question types

WHICH IS MORE ACIDIC?

0.1M CH₃COOH → fair test
0.1M HCl

conc./dilute 一样
basicity 一样
strong/weak 不一样

0.1M H₂CO₃ → 理论上不可能知道
0.1M HCl

conc./dilute 一样
basicity 一样
strong/weak 不一样

可是实际上 strength 影响更大

在 weak acid 里, 只有几 % 的 ionizable H atoms 会 ionize