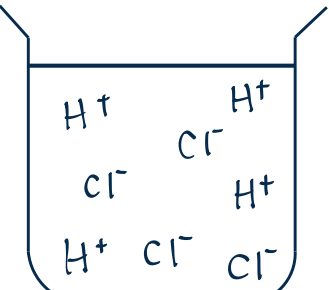
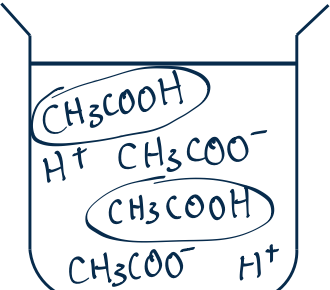


Attributes of acids affecting pH

1 Strong and weak acids

DEFINITION

Strong acids	Weak acids
completely ionizes in water	does not completely ionizes in water
	
$HA \rightarrow H^+ + A^-$ 单向的 reaction	$HB \rightleftharpoons H^+ + B^-$ reversible reaction
HCl, H ₂ SO ₄ , HNO ₃ ↓ pH (basicity 一样时, H ⁺ 更多)	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

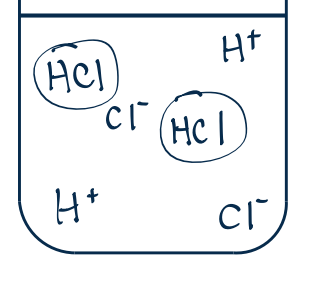
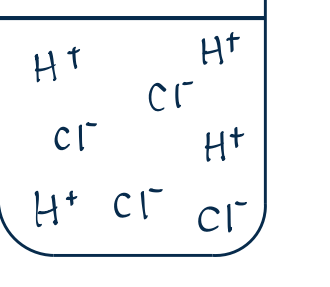
- a. Reaction rate
- React same mass of identical iron w/ same volume of excess 0.1M HCl(aq) and 0.1M CH₃COOH(aq) (Fe + 2H⁺ → Fe²⁺ + H₂)
metal / metal carbonate (带有气泡)
 - 0.1M CH₃COOH(aq) gives bubbles at a slower rate.
 - H⁺ 浓度 ↓ → 粒子碰撞频率 ↓ → reaction rate ↓
 - reaction is exothermic, 放出的热会使 CH₃COOH 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 → 所以 final 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. $HX \rightarrow H^+ + X^-$
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

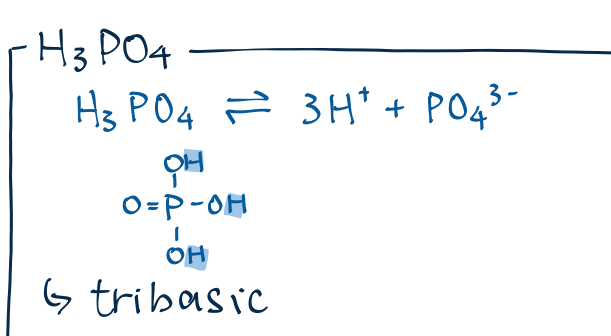
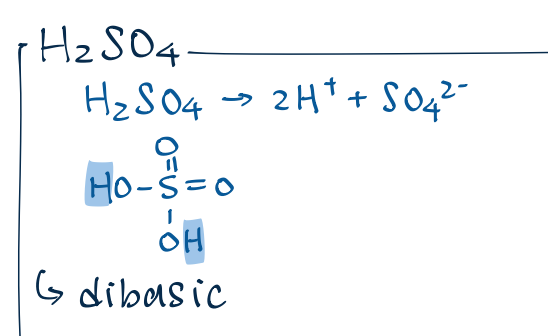
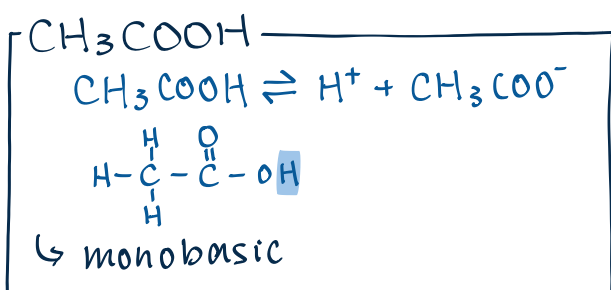
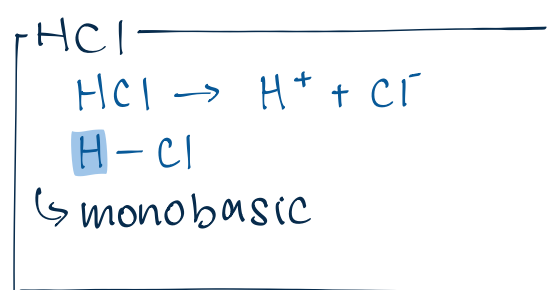
Conc. acids	Dilute acids
13 至 15 M	零点几 - 1 M
	
水不够, 不能 completely ionize	(HCl: strong acid) completely ionize

→ 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.

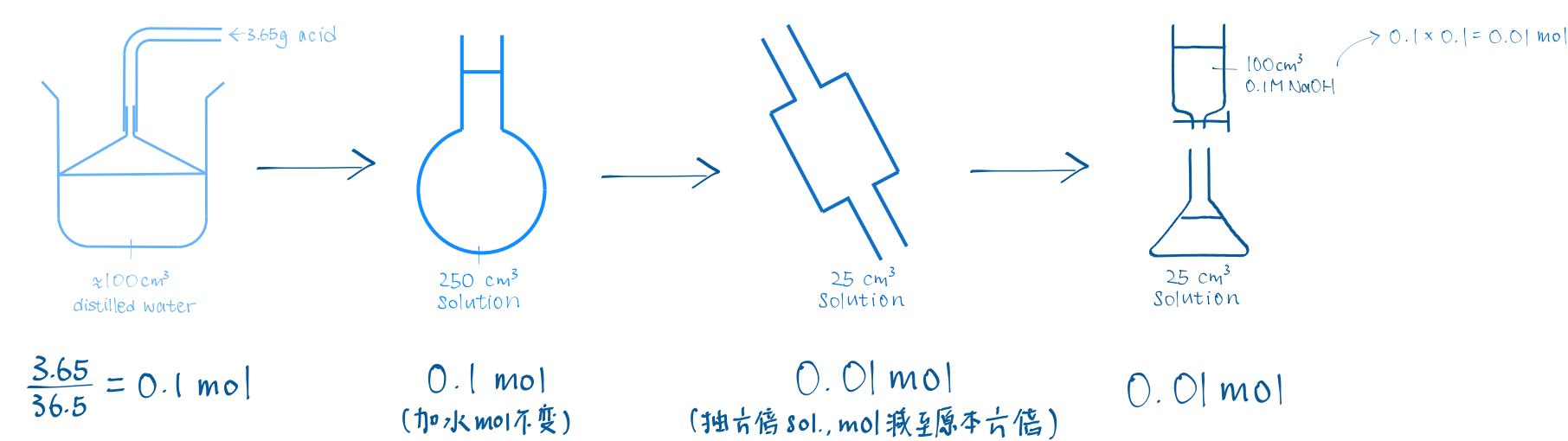
$$\begin{aligned} \text{acid mole} : \text{NaOH mole} &= 1 : 2 \\ n : 2.15 \times 0.03 &= 1 : 2 \\ \text{mole} = \text{molarity} \times \text{volume} & \quad n = 0.0325 \\ \frac{\text{mass}}{M_r} = \text{mole} & \\ \frac{2}{M_r} = 0.0325 & \\ M_r &= 62.0 \end{aligned}$$

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.



$$\begin{aligned} \text{mole of acid} : \text{mole of alkali} & \\ = 0.01 : 0.01 & \\ = 1 : 1 & \\ \therefore \text{monobasic} & \end{aligned}$$

4 Mixed question types

WHICH IS MORE ACIDIC?

- { 0.1M CH₃COOH → fair test (conc./dilute 一样, basicity 一样, strong/weak 不一样)
0.1M HCl
- { 0.1M H₂CO₃ → 理论上不可能知道 (ex-fair test) (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)
0.1M HCl