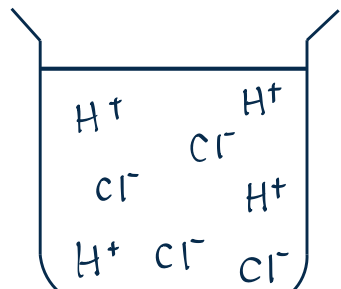
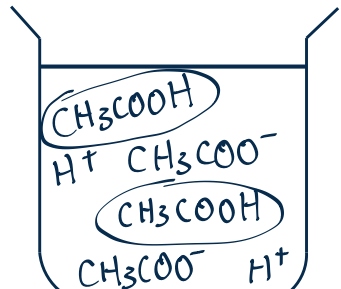


Attributes of acids affecting pH

1 Strong and weak acids

DEFINITION

Strong acids	Weak acids
completely ionizes in water	does not completely ionize 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

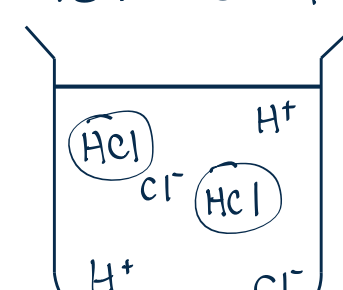
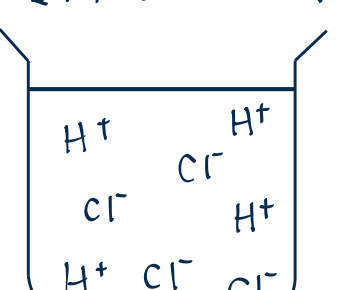
PHYSICAL METHOD	CHEMICAL METHOD
<p>a. pH value</p> <ul style="list-style-type: none">- Prepare same volume of 0.1M HCl(aq) and 0.1M CH₃COOH(aq)- Using pH paper, measure the pH value of both solutions- 0.1M HCl has a lower pH value than 0.1M CH₃COOH(aq).- strong acids → [H⁺] ↑ → pH ↓ <p>b. Electrical conductivity</p> <ul style="list-style-type: none">- 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 ↑	<p>a. Reaction rate</p> <ul style="list-style-type: none">- React same mass of identical iron w/ excess 0.1M HCl(aq) and 0.1M CH₃COOH(aq) (Fe + 2H⁺ → Fe²⁺ + H₂)- 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 (不甘给 excess) 也会被 ionize ↓ ∴ 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) <p>b. Reaction temperature rise</p> <ul style="list-style-type: none">- 如上: react same mass of identical iron w/ same volume of excess 0.1M HCl(aq) & 0.1M CH₃COOH(aq).- 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 → ∴ 部分热用以 ionize CH₃COOH (re 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. $HX \rightleftharpoons H^+ + X^-$
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

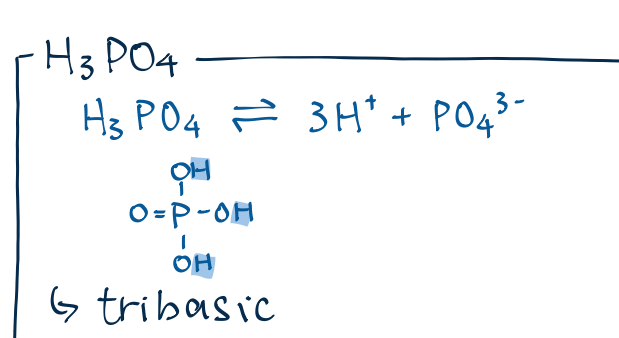
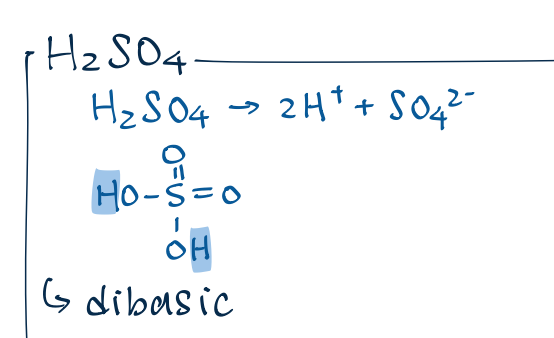
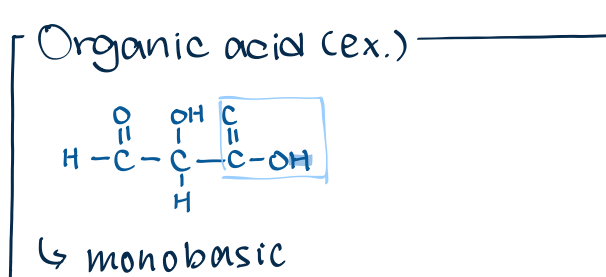
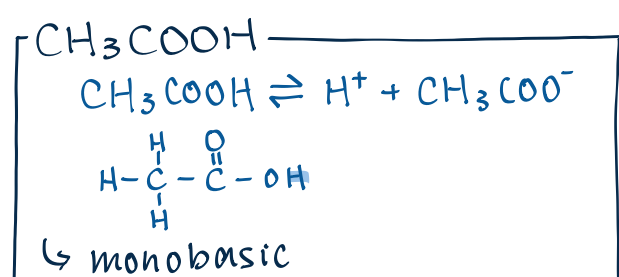
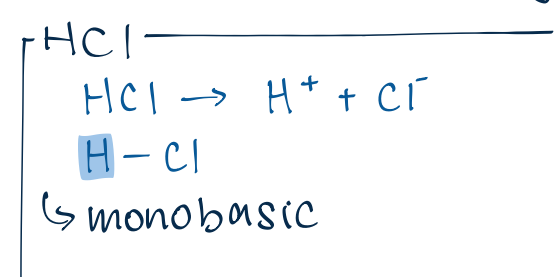
Conc. acids	Dilute acids
13 至 15 M	零点几 - 1 M
	
水不够, 不能 completely ionize	(HCl: strong acid) completely ionize

→ 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

- An acid's basicity 和 base anion 的 charge 判断 mole ratio
- 把两个数字调转, 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.

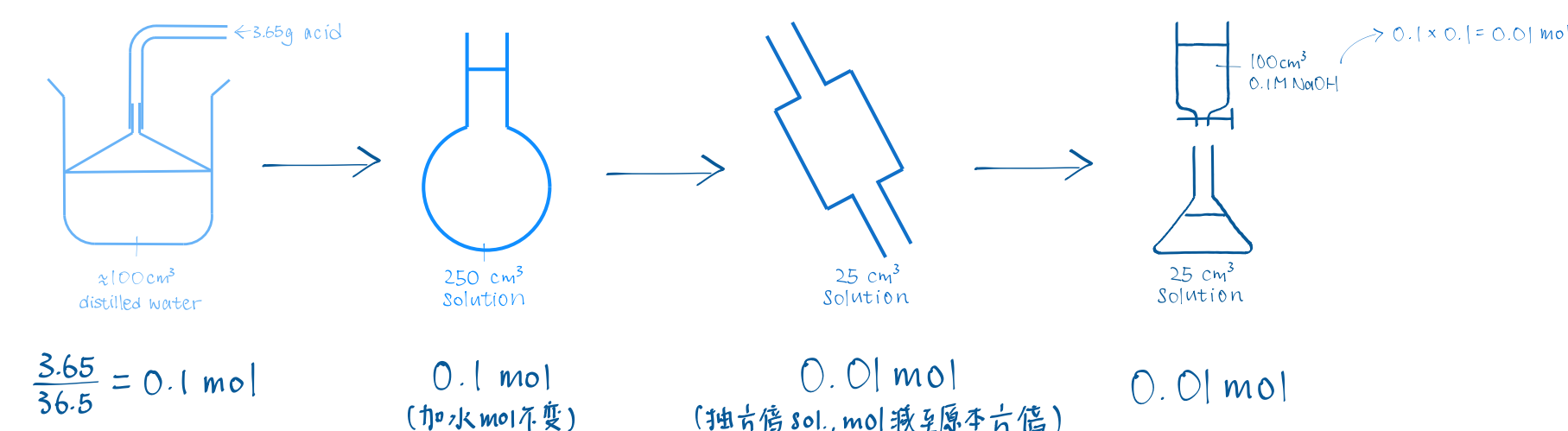
$$\begin{aligned} \text{acid mole} : \text{NaOH mole} &= 1 : 2 \\ n : 2.15 \times 0.03 &= 1 : 2 \\ \text{mole} = \text{molarity} \times \text{volume} & \quad n = 0.0325 \\ \frac{\text{mass}}{\text{Mr}} = \text{mole} & \\ \frac{2}{\text{Mr}} = 0.0325 & \\ \text{Mr} &= 62.0 \end{aligned}$$

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?

- $\left\{ \begin{array}{l} 0.1M \text{ CH}_3\text{COOH} \\ 0.1M \text{ HCl} \end{array} \right\} \rightarrow \text{fair test} \left\{ \begin{array}{l} \text{conc./dilute 一样} \\ \text{basicity 一样} \\ \text{strong/weak 不一样} \end{array} \right.$
- $\left\{ \begin{array}{l} 0.1M \text{ H}_2\text{SO}_4 \\ 0.1M \text{ HCl} \end{array} \right\} \rightarrow \text{理论上不可能知道 (ex-fair test)} \left\{ \begin{array}{l} \text{conc./dilute 一样} \\ \text{basicity 不一样} \\ \text{strong/weak 不一样} \end{array} \right. \rightarrow \text{可是实际上 strength 影响更大} \leftarrow \text{在 weak acid 里, 只有几\% 的 ionizable H atoms 会 ionize}$