

# Metal reactions

## 1 Metal reactivity series

	$K_2O$	←	K (钾)	→	$K^+$	
	$Na_2O$	←	Na (钠)	→	$Na^+$	
白	$CaO$	←	Ca (钙)	→	$Ca^{2+}$	water
	$MgO$	←	Mg (镁)	→	$Mg^{2+}$	
白或黄热	$Al_2O_3$	←	Al (铝)	→	$Al^{3+}$	steam
	$ZnO$	←	Zn (锌)	→	$Zn^{2+}$	
铁锈黄热	$Fe_3O_4$	←	Fe (铁)	→	$Fe^{2+}$	very pale green
黑	$SnO_2$	←	Sn (锡)	→	$Sn^{2+}/Sn^{4+}$	
黄绿橙热	$PbO$	←	Pb (铅)	→	$Pb^{2+}/Pb^{4+}$	dilute acid
黑	$CuO$	←	Cu (铜)	→	$Cu^{2+}$	rare but possible, 看题目找线索
红 (稀有)	$HgO$	←	Hg (汞)	→	$Hg^{2+}$	
黑	$Ag_2O$	←	Ag (银)	→	$Ag^+$	reddish brown

## 2 Reactions

### WITH OXYGEN



mostly require heat, 但比 Mg reactive 的 (ie 钾钠钙) 不用加热

- eg.  $4Na + O_2 \rightarrow 2Na_2O$
- eg.  $3Fe + 2O_2 \rightarrow Fe_3O_4$  ← mixture of ① iron (II) oxide  $FeO$  ② iron (III) oxide  $Fe_2O_3$
- Observable changes
  - > change in colour (metal colour → oxide colour)
  - > change in shininess (metal: shiny → oxide: dull)
  - > flame colour (for Cu, Ca, Na, K, Fe, Mg)

变成 oxide 后的 flame colour: 加热的金属的 flame colour

### WITH NON-METAL ELEMENTS



- 不 reactive 的 (eg.  $N_2$ ) 要加热
- 注意 non-metal 通常是两颗 atom 组成一个 molecule
- $6Na + N_2 \xrightarrow{\Delta} 2Na_3N$
- $2Na + Cl_2 \rightarrow 2NaCl$

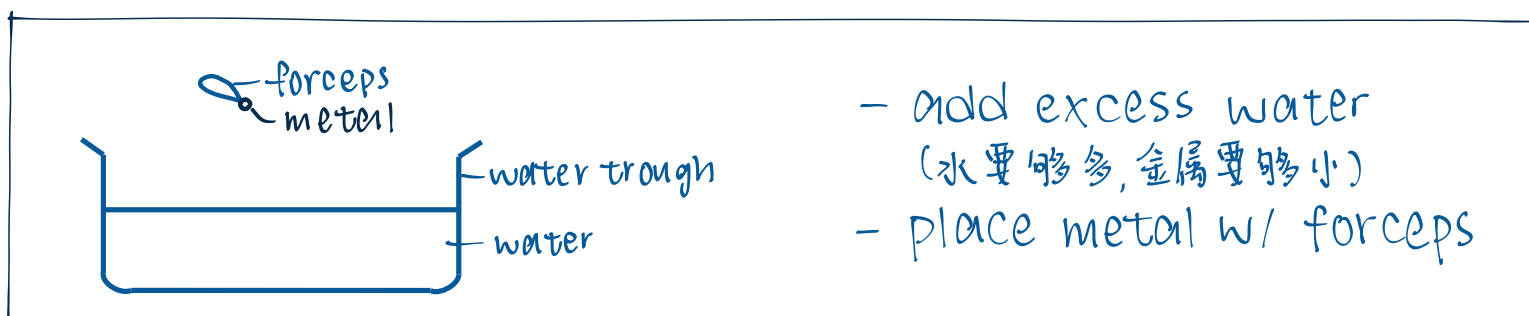
### WITH WATER & ACIDS

#### a. liquid water



假设 metal 的 ion 是 1+

- $\underline{K, Na, Ca, Mg, Al, Zn, Fe} \dots$ 
  - ✓ react at room temp.
  - ✓ react (hot water)
  - x react



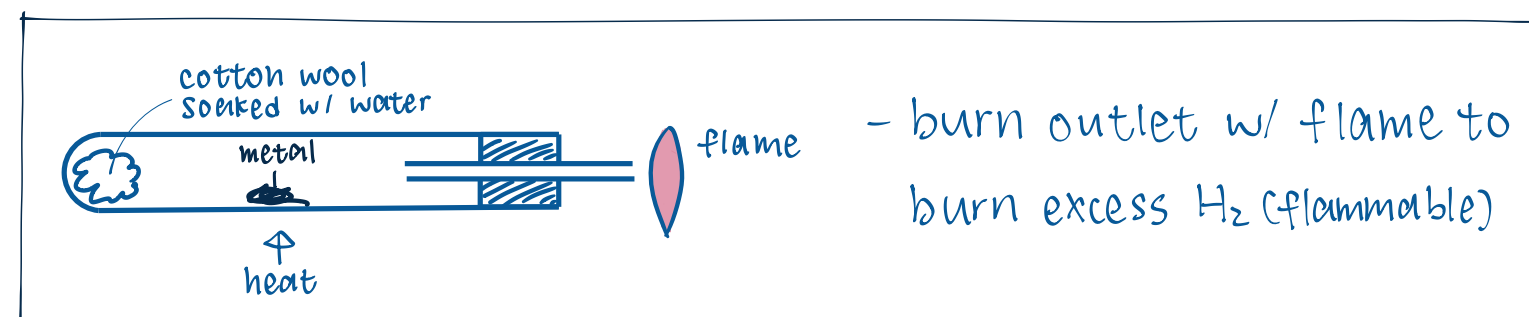
- add excess water (水要够多, 金属要够小)
- place metal w/ forceps

- observable changes
  - > <metal> dissolves
  - > insoluble salt: <colour> solid deposits
  - > soluble salt + coloured ion: solution changes from colourless to <colour>
  - > colourless gas bubbles evolve

#### b. water vapour



- $\underline{K, Na, Ca, Mg, Al, Zn, Fe, Sn, Pb, Cu} \dots$ 
  - ✓ react
  - x react



- burn outlet w/ flame to burn excess  $H_2$  (flammable)

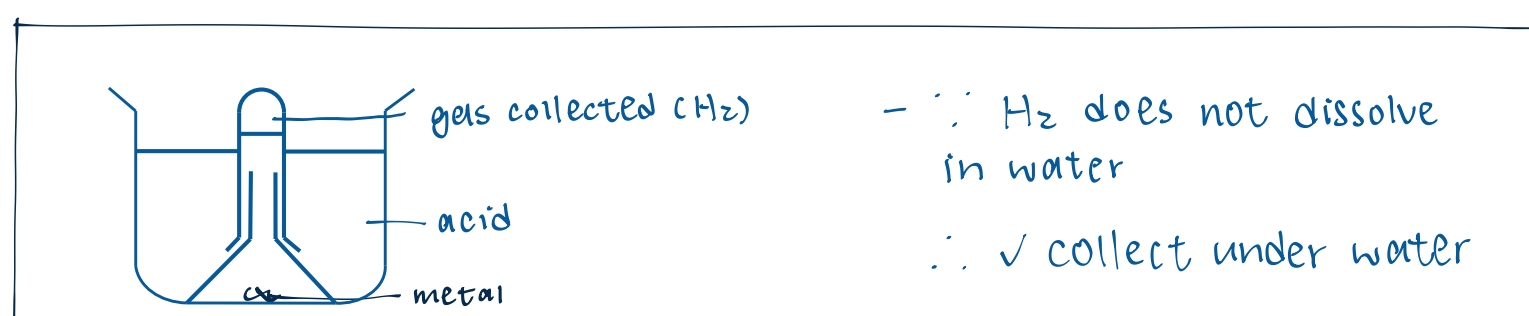
- observable changes
  - > change in colour (metal colour → oxide colour)
  - > change in shininess (metal: shiny → oxide: dull)

#### c. acids



acid: dilute/conc. HCl, dilute  $H_2SO_4$ , very dilute  $HNO_3$ ,  $CH_3COOH$  (for rx of metal & other acids see Acid and Bases topic)

- $\underline{K, Na, Ca, Mg, Al, Zn, Fe, Sn, Pb, Cu, Hg, Ag, Au}$ 
  - ✓ react
  - x react



- $\therefore H_2$  does not dissolve in water
- $\therefore$  ✓ collect under water

- observable changes
  - > <metal> dissolves
  - > insoluble salt: <colour> solid deposits
  - > soluble salt + coloured metal ion: solution changes from colourless to <colour>
  - > colourless gas bubbles evolve