예제 3)

a) $C : 12 \ g/mol$, $H : 1 g/mol$ $O : 16 g/mol$

$$[(12 \times 10) + (1 \times 6) + (16 \times 3)] \ g/mol$$

$$= 120 + 6 + 48 = 174 \ g/mol$$

b) $(g \rightarrow mol \rightarrow 개)$

$$1.56 \times 10^{-2} \ g \times \frac{1 mol}{174 g} = 8.96 \times 10^{-5} \ mol$$

2-4)

ex) $\underline{C_{10}H_6O_3}$ = $\underline{174 g/mol}$
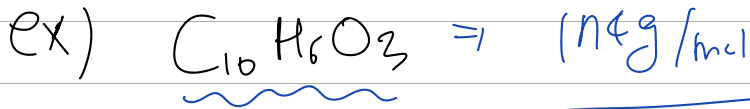
$C : \dfrac{120 g}{174 g/mol} \times 100 = \boxed{}$ %

$H : \dfrac{6 g}{174 g/mol} \times 100 = \boxed{}$ %

$O : \dfrac{48 g}{174 g/mol} \times 100 = \boxed{}$ %

$C_2H_2 \Rightarrow \underline{CH}$ / $C_2H_4 \Rightarrow \underline{CH_2}$
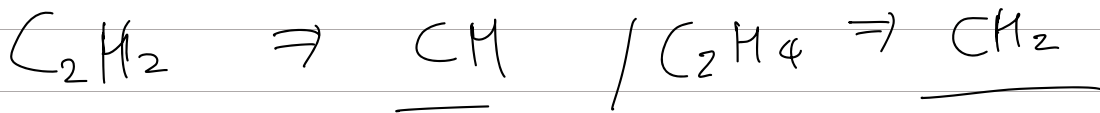
* 실험식 구하기

① 질량조성 백분율 (g %)

원자량 → ② 개수비 (몰비) ⇒ ③ 간단한 정수비

─────────────
① 화합물의 화학식량

④ 분자식 ($\times n$)

예제1) C_2H_5OH (1mol)

$\Rightarrow \{ (12 \times 2) + (1 \times 6) + (16 \times 1) \} = 46 \text{ g/mol}$

$C : \dfrac{24g}{46g} \times 100 = 52.14\%$

$H : \dfrac{6g}{46g} \times 100 = 13.1\%$

$O : \dfrac{16g}{46g} \times 100 = 34.7\%$

예제2)

① 질량조성백분율

$\Rightarrow \quad C : \dfrac{10.8g}{12g/mol} = 0.8892 \text{ mol}$

$H : \dfrac{1.36g}{1g/mol} = 1.36 \text{ mol}$

$$Cl : \frac{47.84 g}{35.5 g/mol} = 1.349 \text{ mol } Cl$$

$$C : H : Cl = 0.8892 : 1.36 : 1.349$$

$$= 2 : 3 : 3$$

$$\boxed{C_2 H_3 Cl_3}$$

예제3)

분자량

실행식 $\Rightarrow$ 분자식
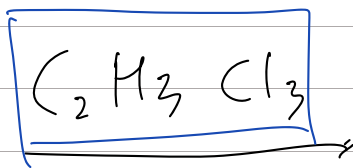
Br : 94.85 %

C : 4.75 %

H : 0.4 %

$\boxed{100g}$ 〔 Br : 94.85 g

C : 4.75 g

H : 0.4 g

$$\Rightarrow \quad Br : \frac{94.85 g}{79.9 g/mol} = 1.187 \text{ mol}$$

$$C : \frac{4.75 g}{12 g/mol} = 0.396 \text{ mol}$$

$$H: \quad \frac{0.4\,g}{1\,g/mol} = 0.4\,mol$$

$$Br : C : H = 1.187 : 0.396 : 0.4$$

$$= 3 : 1 : 1$$

실험식: $Br_3 CH$ + 분자량

$$(79.9 \times 3) + (12 \times 1) + (1 \times 1) = \boxed{252.72\,g/mol}$$

$\downarrow$ (×2)

$$\boxed{505.44\,g/mol}$$

분자식: $(Br_3CH)_2 = Br_6 C_2 H_2$

예제 4)

C: 47.08%   C: 47.08 g
                100 g ⟹
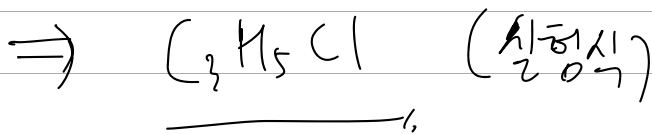H: 6.59%   H: 6.59 g

Cl: 46.33%   Cl: 46.33 g

$$C : \frac{47.08g}{12g/mol} = 3.92 mol$$

$$M : \frac{6.59g}{1g/mol} = 6.59 mol$$
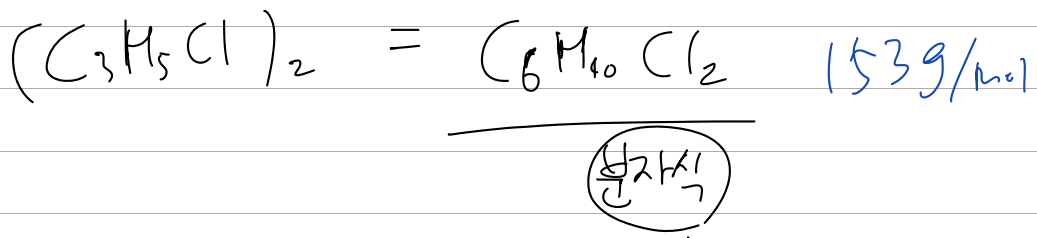
$$Cl : \frac{46.33g}{35.5g/mol} = 1.307 mol$$

$$C : M : Cl = 3.92 : 6.59 : 1.307$$

$$= 3 : 5 : 1$$

$$\Rightarrow C_3H_5Cl \quad (실험식)$$

$$(12\times3) + (1\times5) + (35.5\times1) = \frac{76.5g/mol}{\Downarrow \times 2}$$

$$(C_3H_5Cl)_2 = C_6H_{10}Cl_2 \quad 153g/mol$$

$$(\underline{분자식})$$

ex) C_2H_4 ~~완전~~ 가 연소반응! /~ 완전연소반응!

O_2

↳ 생성물 CO_2, H_2O

C_2H_4 + O_2 / → ☐ + ☐

H_2O CO_2

CH C_1H_1O + O_2

→ H_2O + CO_2

H의 질량   C의 질량!

O_2 → [CO_2 H_2O] → ( ) → ( )

$1g$ → $1.3g$ $1g$ → $2g$
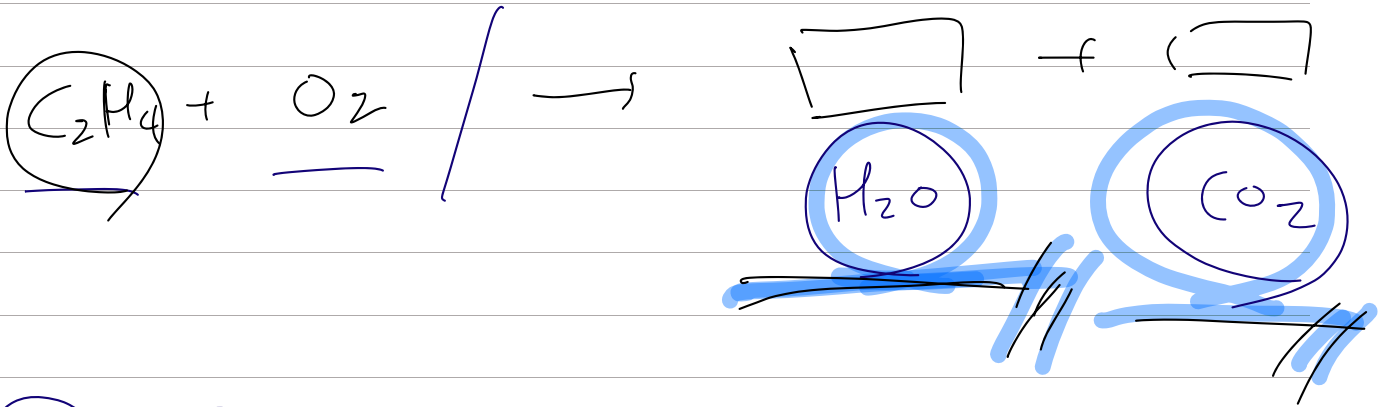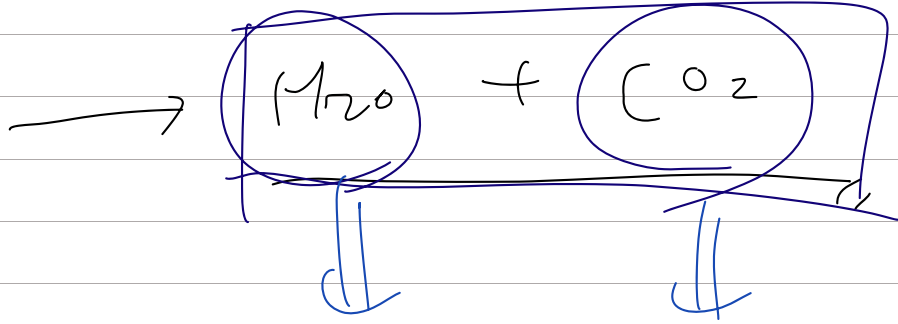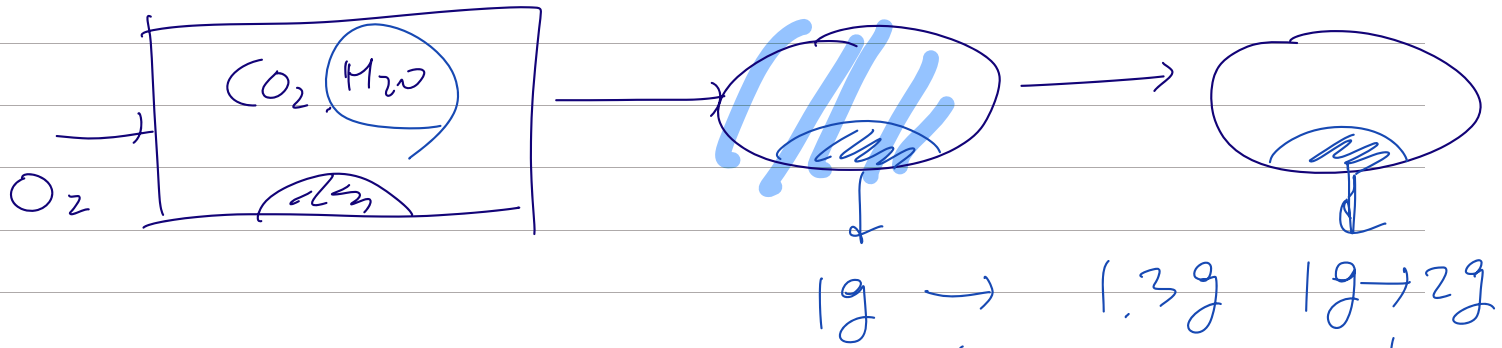
$H_2O = 0.3g$ $CO_2 = 1g$

$\times \frac{2}{18}$ $\times \frac{12}{44}$

H의질량!   O의질량!

$(2 \times 1) + (16 \times 2) = 44$

CO_2 : $1g \times \dfrac{12g}{44g}$ = C의질량
44g

H_2O : $0.3g \times \dfrac{2g}{18g}$ = H의질량
18g

(C - H O) ⇒ $10g$
    ↓   ↓ ??
   $0.1g$ $1g$ $1g - (0.1H)$

= $8.9g$

✡ 일반적인 연소비료 분석 (실험식 + 분자식)

C, H, O 질량을 간접적으로 제시

① C의질량 : 흡수된 CO_2질량 × $\boxed{\dfrac{12}{44}}$ = ag

② H의질량 : 흡수된 H_2O질량 × $\boxed{\dfrac{2}{18}}$ = bg

③ O의질량 : 전체시료 − (C의질량 + H의질량) = cg

⇓

C : $\dfrac{a}{12g/mol}$ = $\dfrac{a}{12}$ mol

H : $\dfrac{bg}{1g/mol}$ = b mol

O : $\dfrac{cg}{16g/mol}$ = $\dfrac{c}{16}$ mol

분자식

↑ 몰질량

$C_mH_nO_k$
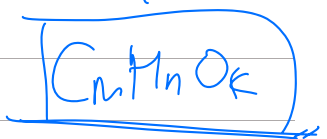
C : H : O = $\boxed{\dfrac{a}{12} : b : \dfrac{c}{16}}$ ⇒ $m : n : k$

예제)

C : 3.381 g × $\left(\dfrac{12}{44}\right)$ = $\boxed{0.9226 \ g \ C}$

H : 0.692 g × $\left(\dfrac{2}{18}\right)$ = $\boxed{0.0774 \ g \ H}$

$\Downarrow$

C : $\dfrac{0.9226 \ g}{12 g/mol}$ = 0.0768 mol C

H : $\dfrac{0.0774 \ g \ H}{1 g/mol}$ = 0.0774 mol H

C : H = 0.0768 : 0.0774 = $\left| \ddot{\cdot} \right|$
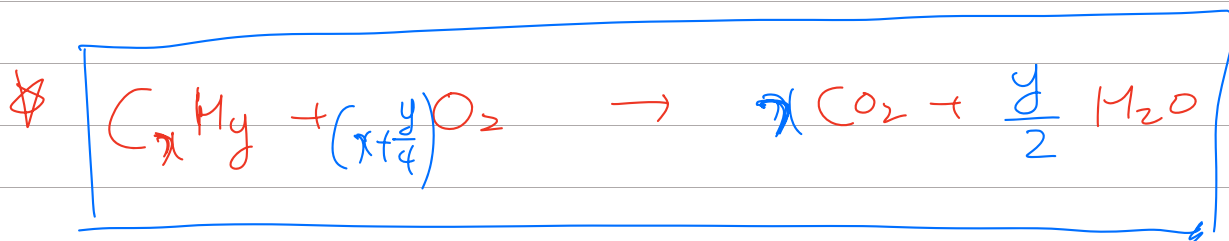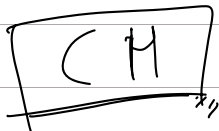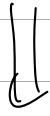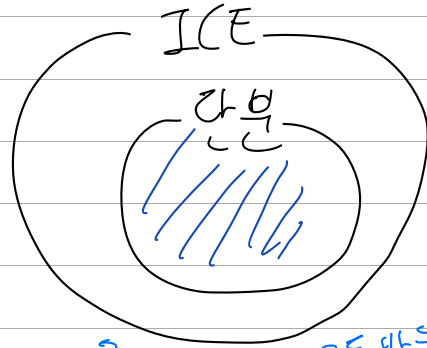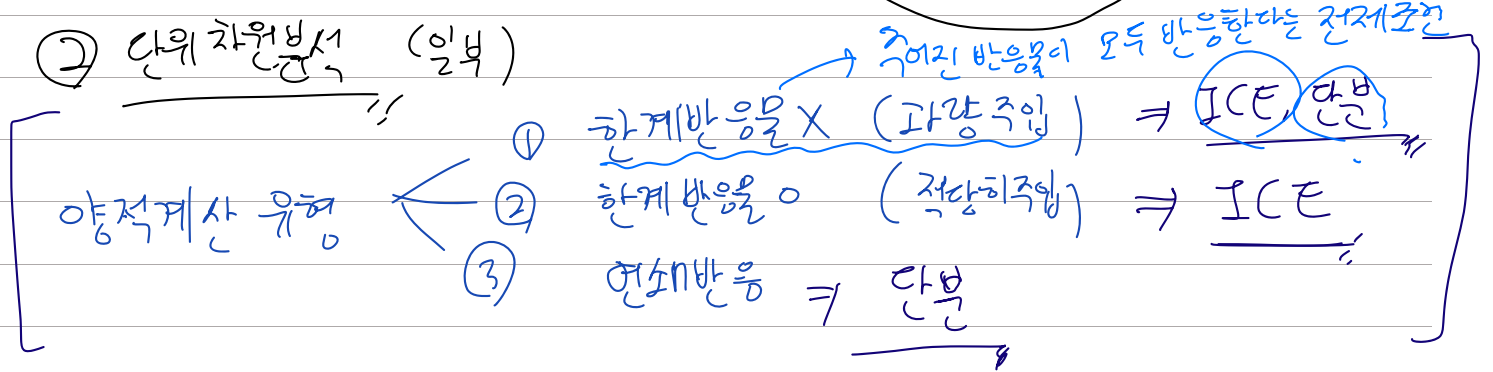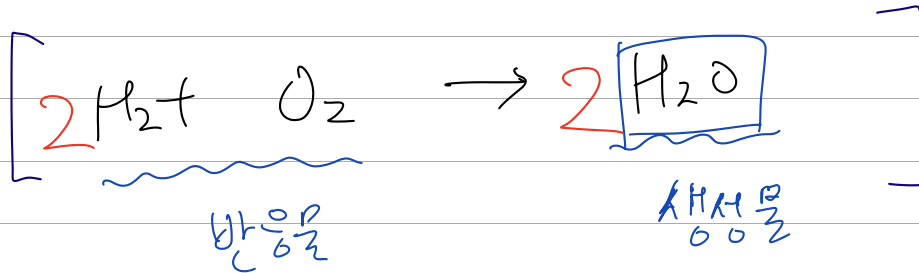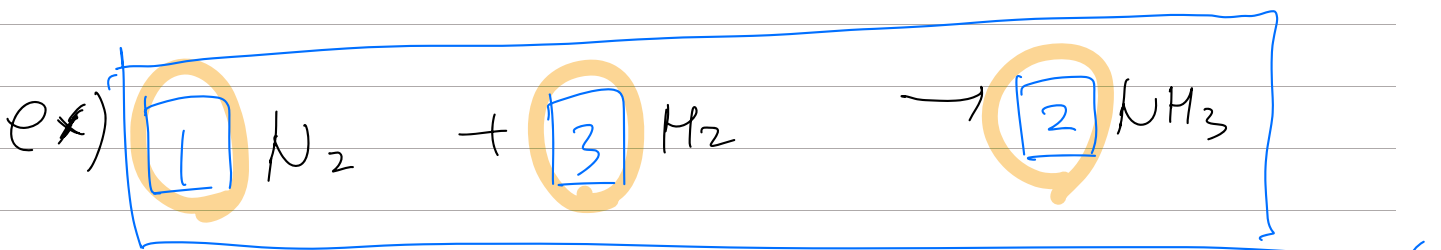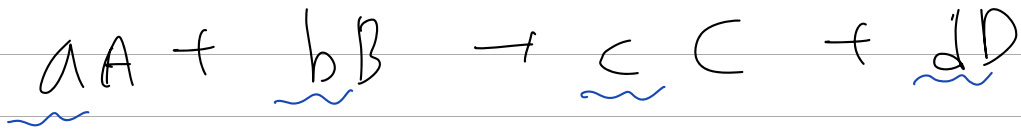
$\boxed{C H}$

※ $\boxed{C_x H_y + \left(x + \dfrac{y}{4}\right) O_2 \longrightarrow x CO_2 + \dfrac{y}{2} H_2O}$

① 모든 양적 계산   (ICE)

$\parallel$

ICE

단분

② 단위 차원분석 (일부)

양적계산 유형

① 한계반응물 X (과량주입) ⇒ ICE, 단분

② 한계반응물 O (적당히주입) ⇒ ICE

③ 연쇄반응 ⇒ 단분

→ 주어진 반응물이 모두 반응한다는 전제조건

✗ 화학반응식 ⇒ 원자수가 보존 ⇒ 균형화학반응식

$$2H_2 + O_2 \longrightarrow 2\boxed{H_2O}$$

반응물   생성물

H : 2 (4) $\longrightarrow$ H : 2 (4)

O : 2 $\longrightarrow$ O : 1 (2)

ex) $\boxed{1}\,N_2 + \boxed{3}\,H_2 \longrightarrow \boxed{2}\,NH_3$

$$aA + bB \rightarrow cC + dD$$

(계수 : 반응 물의 반응 정도와 생성물의 생성정도의 비율!)

$$5A + 2B \rightarrow 10C + 20D$$

(5mol 의 A가 반응 $\Rightarrow$ 2mol 의 B 반응

$\Rightarrow$ 10mol 의 C 생성

$\Rightarrow$ 20mol 의 D 생성)

ICE

단위분석

$\Rightarrow$ (20mol A 반응 $\Rightarrow$ 8mol B 반응

$\Rightarrow$ 40mol C 생성

$\Rightarrow$ 80mol D 생성)

ex) $2H_2 + O_2 \longrightarrow$ ② H_2O_2

H_2 : 4mol 반응 $\Rightarrow$ $\begin{cases} O_2 : x \text{ mol} \\ H_2O : y \text{ mol} \end{cases}$

$\sim$ ⊄
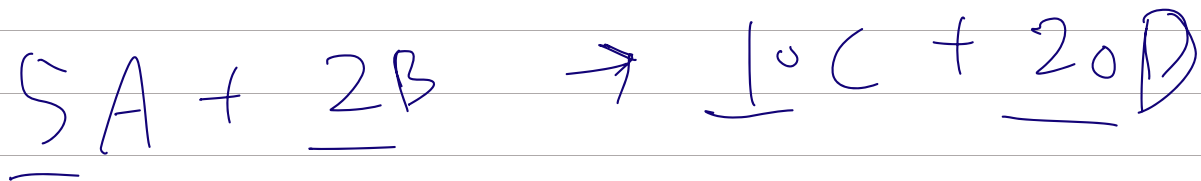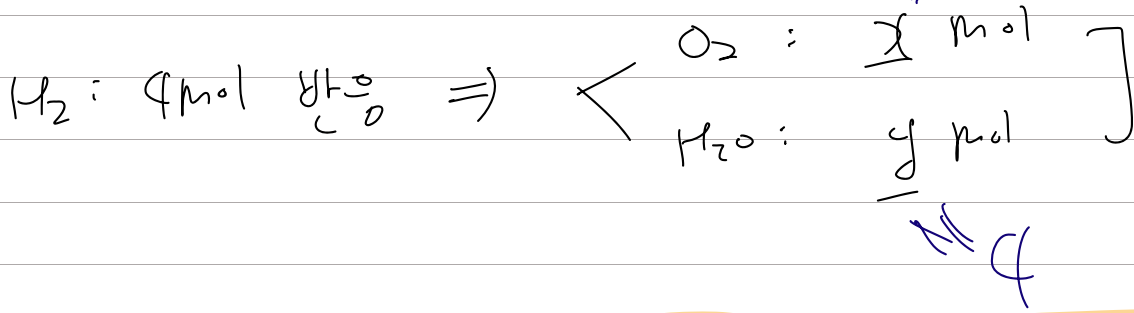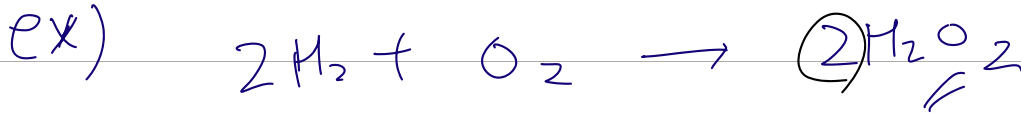
$2 : 1 : 2$ $\Rightarrow$ 반응계수비 = 반응몰수비

$=$ 반응 분자수비

$\neq$ 반응질량비

① ICE

$2H_2 + O_2 \longrightarrow 2H_2O$
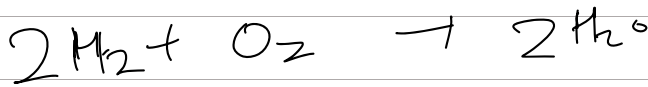
반응전 I 4mol   100mol

반응 C -4 -2 $+4$

반응후 E 0   98mol   4mol

② 단위차원

4mol H_2 × $\dfrac{2\text{mol } H_2O}{2\text{mol } H_2}$ = 4 mol H_2O

※ 한계 반응물

$$N_2 \ + \ 3H_2 \ \longrightarrow \ 2NH_3$$

① $\begin{cases} N_2 : 4mol \\ H_2 : \text{과량} \end{cases}$ = 단위 - ③ $\begin{cases} N_2 : 3mol \\ H_2 : 6mol \end{cases}$ ICE

② $\begin{cases} N_2 : 2mol \\ H_2 : 7mol \end{cases}$ ICE

⇒ ① ($N_2 + 3H_2 \longrightarrow 2NH_3$)

I   4mol   과량
C   -4mol   -12mol   +8mol
E

     0mol   남아
      ‖   ‖
    한계반응   초과반응물

    7mol   21mol

② $N_2 + 3H_2 \rightarrow 2NH_3$

I	2 mol	n mol	
C	−2 mol	−6 mol	+4 mol
E	0	1 mol	4 mol

③ $N_2 + 3H_2 \rightarrow 2NH_3$

I	3 mol	6 mol	
C	−2 mol	−6 mol	+4 mol
E	1 mol	0 mol	4 mol
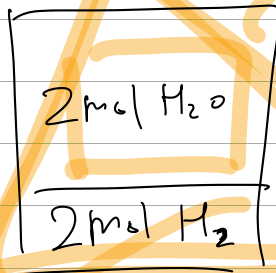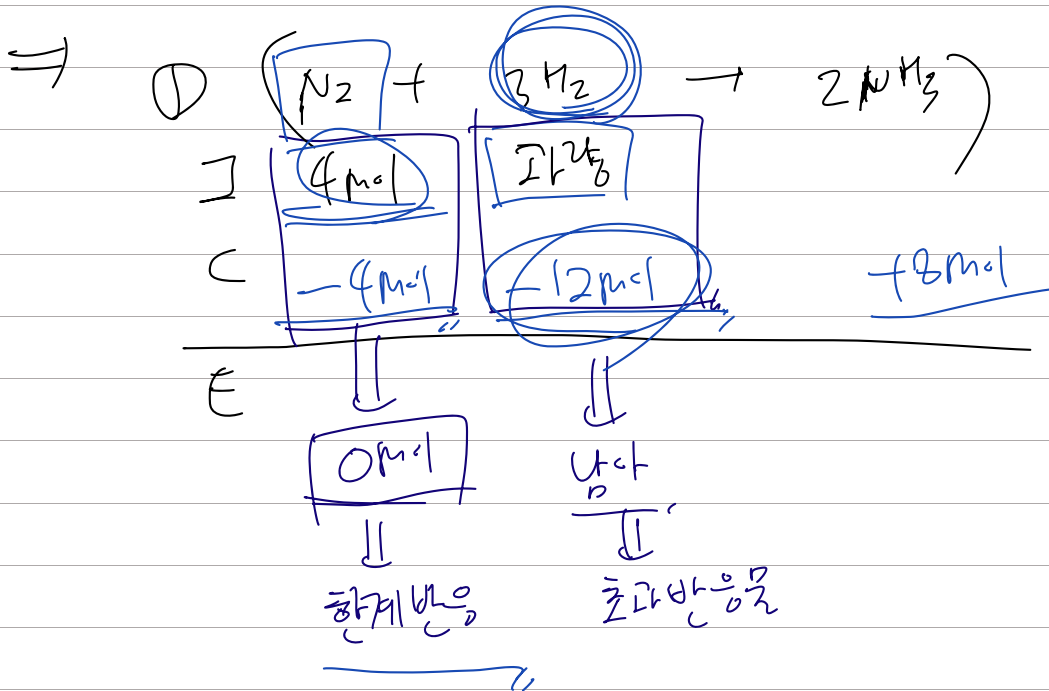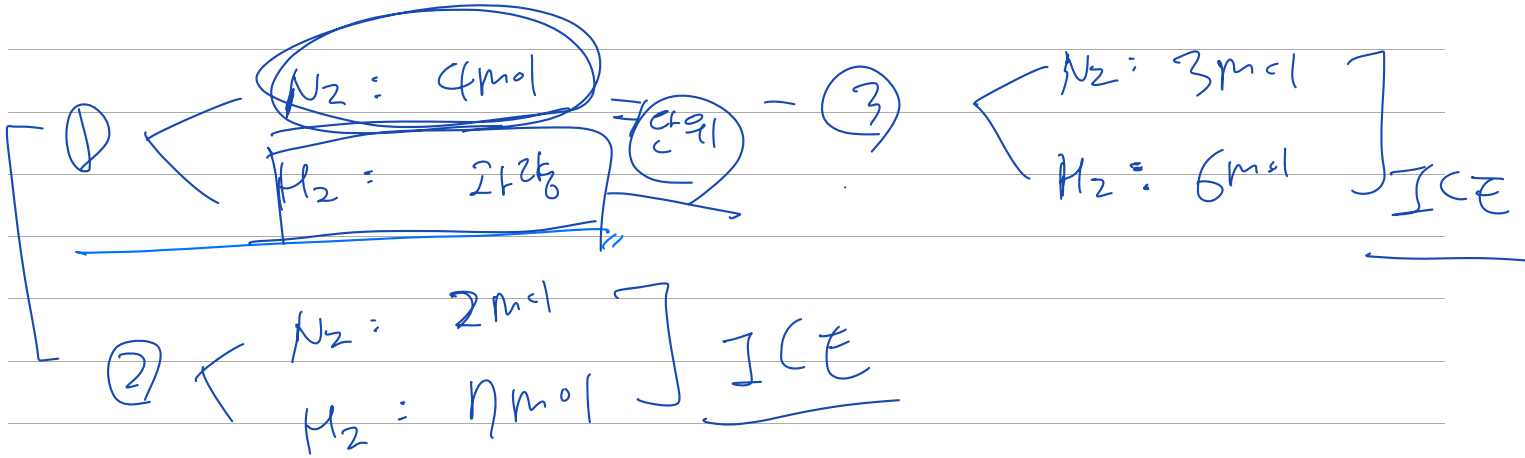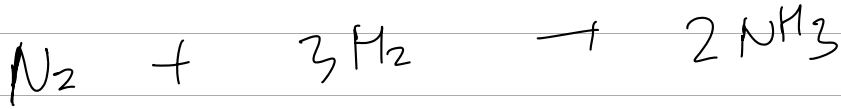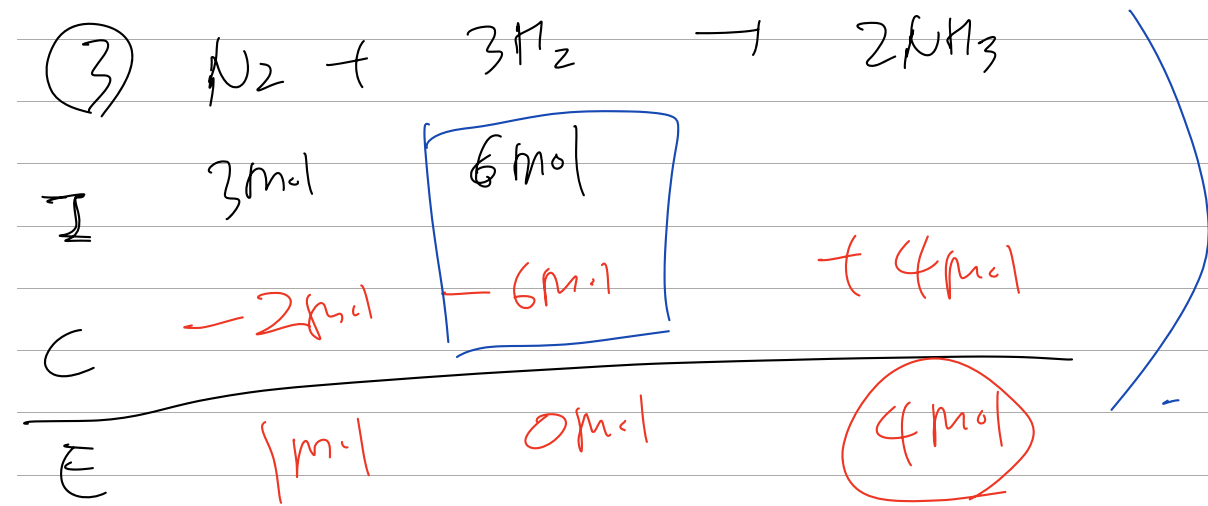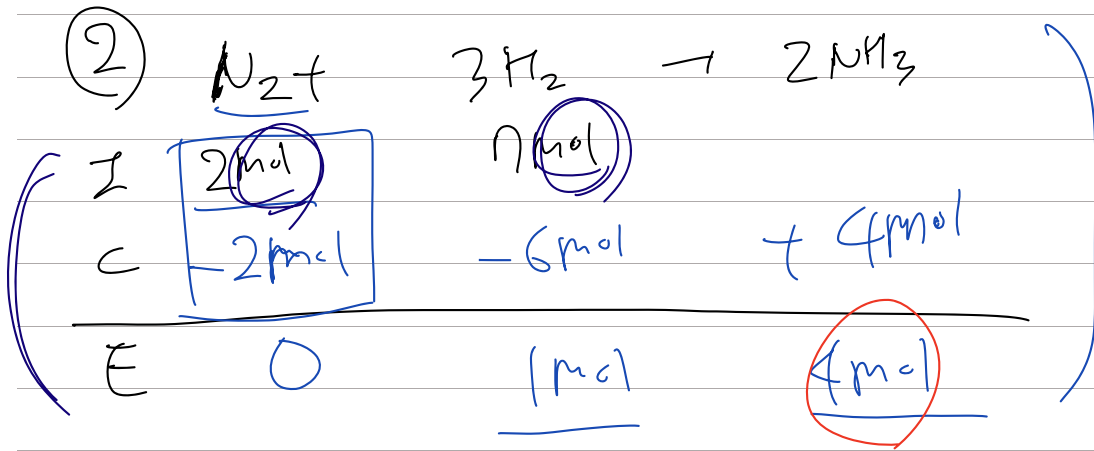
예제1) (① g → mol , ② ICE / 단분)

① $n_{NaHCO_3} = \dfrac{0.01g}{84 g/mol} = 1.19 \times 10^{-4} mol$

$\quad \rightarrow (23 \times 1) + (1 \times 1) + (12 \times 1) + (16 \times 3)$

$\quad = 84 g/mol$

②   i) ICE

$3NaHCO_3 +$ $C_6H_8O_n \rightarrow$ $3CO_2 + 3H_2O +$ $Na_3C_6H_5O_n$
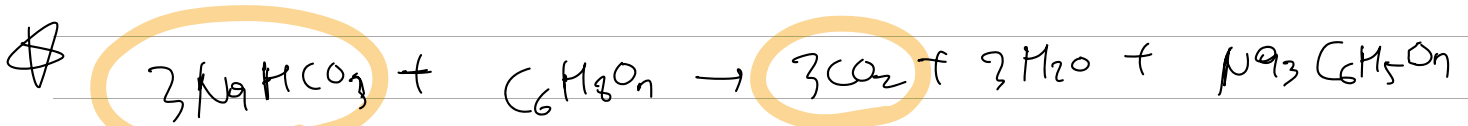
I $1.19 \times 10^{-4} mol$

C $-1.19 \times 10^{-4} mol$ $+1.19 \times 10^{-4} mol$

E $0 mol$ $1.19 \times 10^{-4} mol$

$$W_{CO_2} = \left(1.19 \times 10^{-4} mol\right)\left(44 g/mol\right)$$

$$= 5.24 \times 10^{-3} g \qquad \left[\boxed{n = \frac{w}{M.w}} \quad \therefore w = n(M.w)\right]$$

ii) 단위차원 분석

$1.19 \times 10^{-4} mol \; NaHCO_3 \times \boxed{\dfrac{3 mol \; CO_2}{3 mol \; NaHCO_3}} = 1.19 \times 10^{-4} mol \; CO_2$

$$\Updownarrow$$

$$\boxed{5.24 \times 10^{-3} g}$$

예제 2)

ф 산염기 중화반응 : $[H^+ + OH^- \rightarrow H_2O]$

산 + 염기 → 물

i) ICE → 모두 반응! $\left(\begin{array}{c} ICE \\ 단법 \end{array} \right)$

1g $NaHCO_3 + HCl \rightarrow NaCl + H_2O + CO_2$

I $\frac{1}{84}$mol

C $-\frac{1}{84}$mol $-\frac{1}{84}$mol

제산효과!

E 0

$\rightarrow \frac{1}{84}$ mol (제산효과)

ii) 단법

$\frac{1}{84}$mol $NaHCO_3 \times \dfrac{1mol \ HCl}{1mol \ NaHCO_3} = \frac{1}{84}$ mol HCl

② 1g $Mg(OH)_2 + 2HCl \rightarrow 2H_2O + MgCl_2$

$$
\begin{array}{l}
I \quad \boxed{\dfrac{1g}{58.3g/mol}} \\[2mm]
C \quad -\dfrac{1}{58.3} \quad \boxed{-\left(\dfrac{1}{58.3} \times 2\right)mol} \quad \Rightarrow \text{제산들과} \\[2mm]
\hline
E \quad \boxed{\dfrac{2}{58.3}mol}
\end{array}
$$
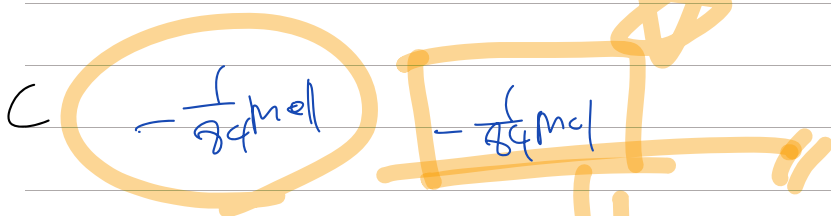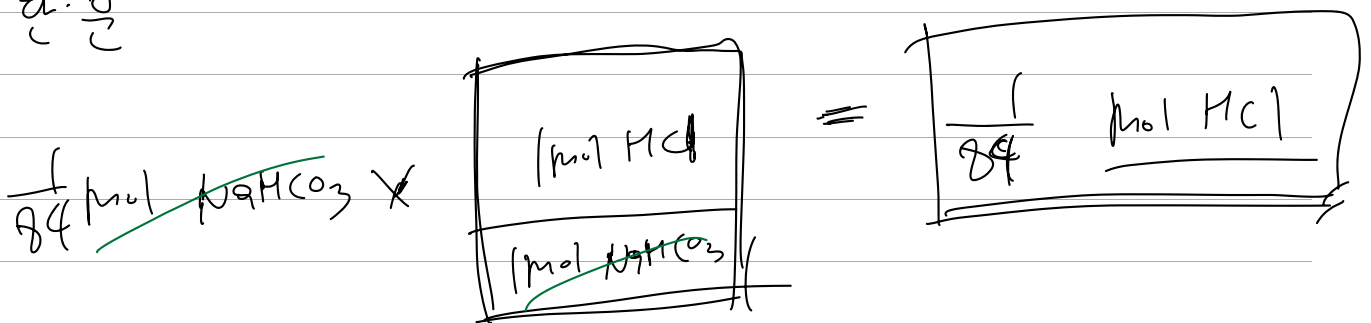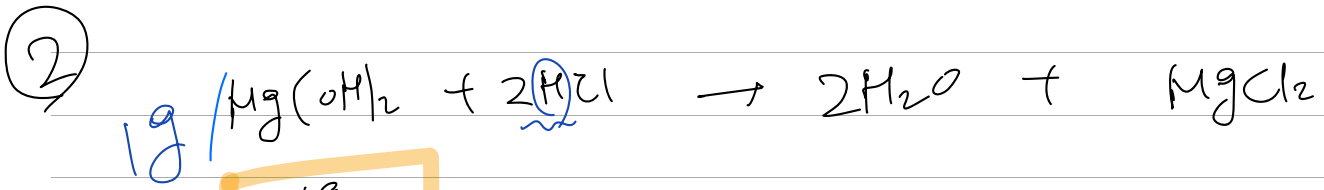
(i) 답.분

$$\boxed{\dfrac{1}{58.3}mol\ Mg(OH)_2} \times \boxed{\dfrac{2mol\ HCl}{1mol\ Mg(OH)_2}} = \boxed{\dfrac{2}{58.3}}mol\ HCl$$

$$\dfrac{1}{84} < \boxed{\dfrac{2}{58.3}} \qquad Mg(OH)_2$$

예제 3) $n_{NH_3} = \dfrac{10g}{Mg/mol}$ $n_{HCl} = \dfrac{10g}{36.5g/mol}$

$$NH_3 \quad + \quad HCl \quad \longrightarrow \quad NH_4Cl$$
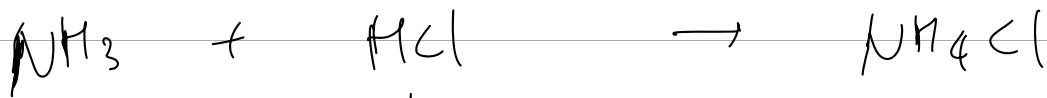
I $\dfrac{10}{M}$mol $\dfrac{10}{36.5}$mol

C $-\dfrac{10}{36.5}$mol $-\dfrac{10}{36.5}$mol $+\dfrac{10}{36.5}$mol

---

E $\left(\dfrac{10}{M} - \dfrac{10}{36.5}\right)$mol   0 mol $\dfrac{10}{36.5}$mol

$\Downarrow (\times M.w)$ $\Downarrow (\times M.w)$

$$W_{NH_3} = \left(\dfrac{10}{M} - \dfrac{10}{36.5}\right) mol \times (Mg/mol) = \boxed{5.4g}$$

$$W_{HCl} = \underline{0g}$$

$$W_{NH_4Cl} = \dfrac{10}{36.5} mol \times (53.5 g/mol) = \boxed{4.45g}$$

예제 4)

$n_{NH_3} = \dfrac{18.1g}{17g/mol}$ $n_{CuO} = \dfrac{90.4g}{79.5g/mol}$
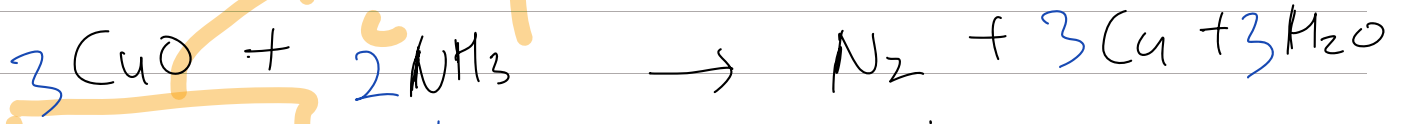
한계

$$3CuO + 2NH_3 \longrightarrow N_2 + 3Cu + 3H_2O$$

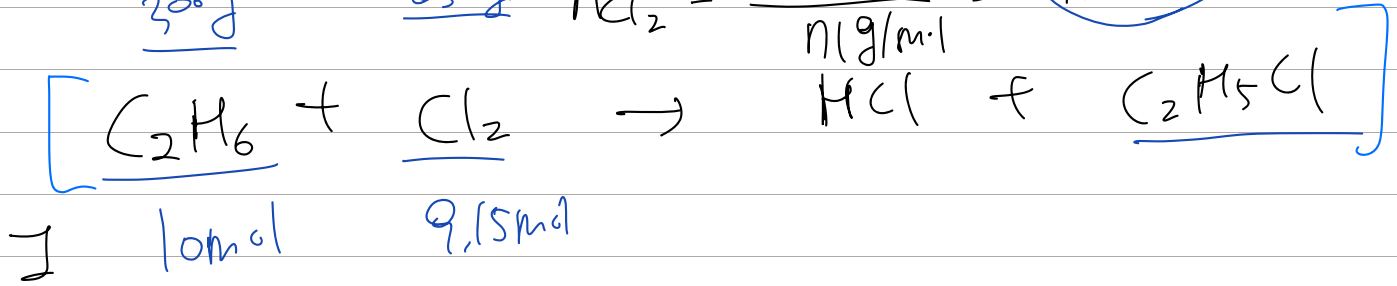|			
I	$\dfrac{90.4}{79.5} = 1.13n$	$\dfrac{18.1}{17} = 1.065$	
C	$-1.13n$	$-(1.13n \times \dfrac{2}{3}) = 0.758mol$	$+(1.13n \times \dfrac{1}{3})mol$
E	0	??	$(1.13n \times \dfrac{1}{3})mol$

한계 : CuO

N_2 : $(1.13n \times \dfrac{1}{3})mol \times (28g/mol)$

$= 10.6g$

$*$ 수득백분율 $= \dfrac{\text{실제 수득량}}{\text{이론적 수득량}} \times 100$

예제 5)

$n_{C_2H_6} = \dfrac{300g}{30g/mol} = \boxed{10 \, mol}$

$n_{Cl_2} = \dfrac{650g}{71g/mol} = \boxed{9.15 \, mol}$

300g   650g

$$\left[C_2H_6 + Cl_2 \longrightarrow HCl + C_2H_5Cl \right]$$

I   10mol   9.15mol

C -9.15 -9.15 $+9.15 \, mol$ $\boxed{+9.15 \, mol}$

E   0.85mol   0 mol

$W_{C_2H_5Cl} = (9.15 \, mol)(64.5 \, g/mol) = \boxed{591 \, g}$

이론적수득량

490g $=$ 실제수득량

$\Rightarrow \dfrac{490g}{591g} \times 100 = \boxed{82.8 \, \%}$

예제 6) $n_{Ca(OH)_2} = \dfrac{1067g}{74g/mol} = \underline{14.4\,mol}$

$2\,NaOH + Ca(OH)_2 + 2\,Cl_2 \rightarrow \underline{Ca(OCl)_2 + 2NaCl + 2H_2O}$
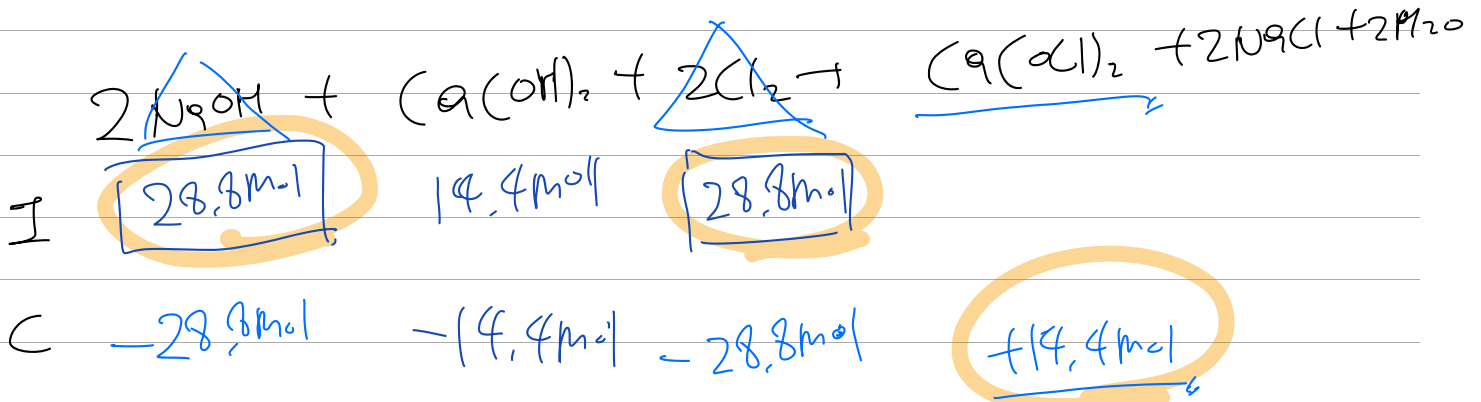
I	28.8 mol	14.4 mol	28.8 mol
C	−28.8 mol	−14.4 mol	−28.8 mol	+14.4 mol
E			

① 반응하는 $NaOH\,(g)$

$\Rightarrow (28.8\,mol)(40g/mol) = \underline{1152g}$

② 반응하는 $Cl_2\,(g)$

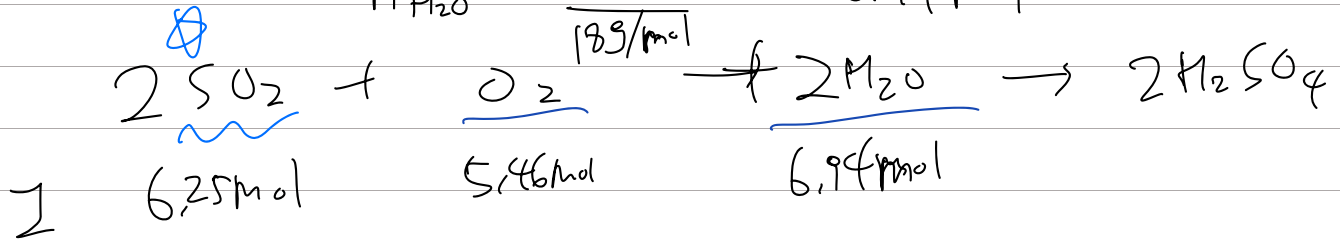$\Rightarrow (28.8\,mol)(71g/mol) = \underline{2044g}$

③ 생성된 $Ca(OCl)_2\,(g)$

$\Rightarrow (14.4\,mol)(143g/mol) = \underline{2059g}$

M.w $\cancel{\text{※}}$ 단위와 원분석 $\Rightarrow$ mol $\xrightarrow{\times M.w}$ g

예제 7)

$$n_{SO_2} = \frac{400g}{64g/mol} = 6.25 mol$$

$$n_{O_2} = \frac{175g}{32g/mol} = 5.46 mol$$

$$n_{H_2O} = \frac{125g}{18g/mol} = 6.94 mol$$

$$2 SO_2 + O_2 + 2H_2O \rightarrow 2H_2SO_4$$

I	6.25 mol	5.46 mol	6.94 mol	
C	−6.25 mol	−3.125 mol	−6.25 mol	+6.25 mol
E	0	2.335 mol	0.69 mol	+6.25 mol

한계반응물 : SO_2

$H_2SO_4 (g) \Rightarrow (6.25 mol)(98g/mol) = 612.5 g$

$O_2 (g) \Rightarrow (2.335 mol)(32g/mol) = 75 g$

$H_2O (g) \Rightarrow (0.69 mol)(18g/mol) = 12.42 g$

예제 8)

$$ZnS \xrightarrow{①} \boxed{ZnO} \xrightarrow{②} Zn$$

5.32kg (ZnS 아래)

3.3kg

실제수득량
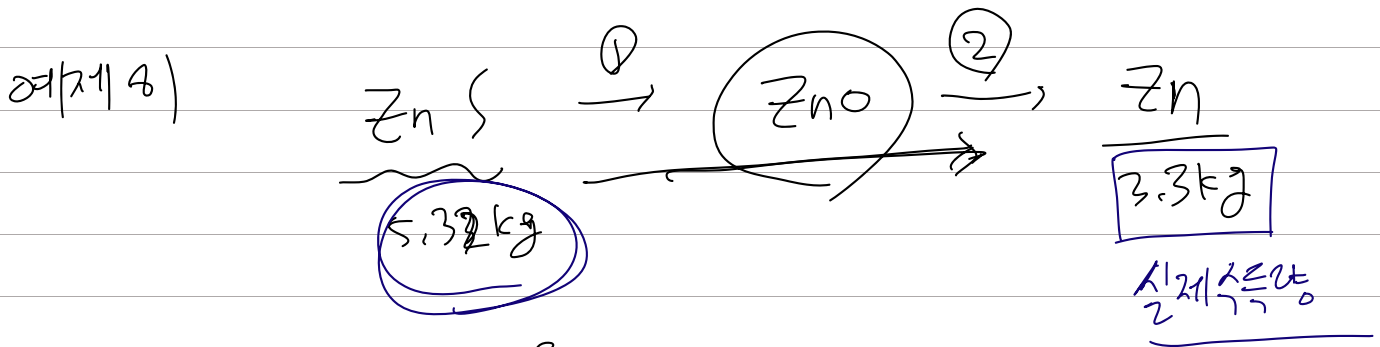
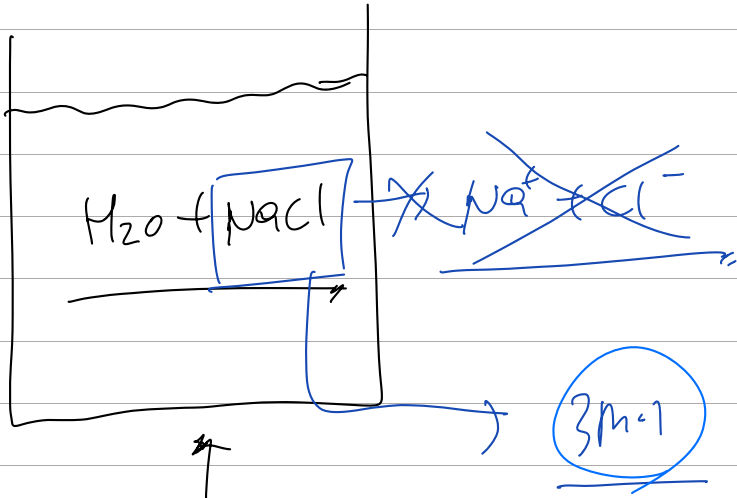$$n_{ZnS} = \frac{5320 \text{ g}}{94.5 \text{ g/mol}} = 56.3 \text{mol}$$

$$n_{Zn} = \frac{3300 \text{ g}}{65.38 \text{ g/mol}} = \boxed{50.5 \text{mol}}$$

① 이론적수득량

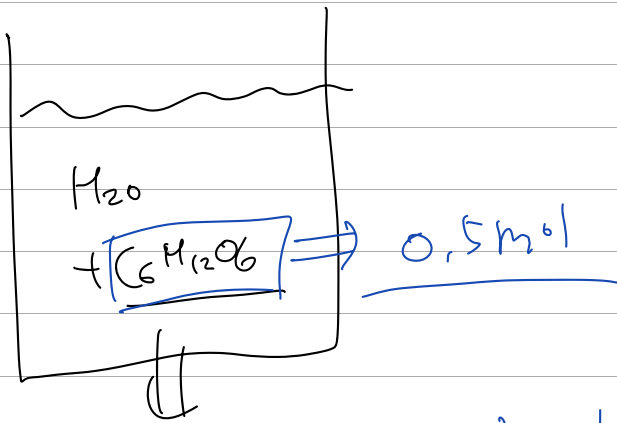$$56.3 \text{mol } ZnS \times \left[\frac{1 \text{mol } ZnO}{1 \text{mol } ZnS} \times \frac{1 \text{mol } Zn}{1 \text{mol } ZnO} \right]$$

$$= \boxed{56.3} \text{ mol } Zn$$

$$\% \text{ 수율} = \frac{50.5 \text{mol}}{56.3 \text{mol}} \times 100 = 92.4\%$$

$H_2O + \boxed{NaCl} \longrightarrow \cancel{\times Na^+ \times Cl^-}$

$\boxed{3mol}$

↑
소금물 $(1L)$

$M = 3M = \dfrac{\text{용질 몰이수}}{\text{부피}(L)} = 3M$

H_2O
$+ \boxed{C_6H_{12}O_6} \Rightarrow 0.5mol$

물에 500ML

$\Rightarrow M = \dfrac{0.5mol}{0.5L}$

$= 1(mol/L)$

$\boxed{M} = \dfrac{n}{U}$
$\left[\begin{array}{l} M \Rightarrow \boxed{\text{몰농도}} \\ m, w \Rightarrow \text{몰질량} \end{array}\right]$
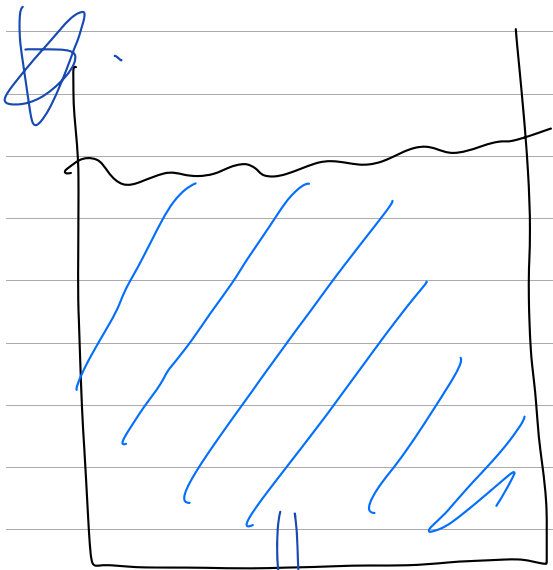
물 1kg

$\rightarrow$ 포도당 = 180g
$(C_6H_{12}O_6)$
(180g/mol)

$m = \dfrac{1mol}{1kg}$

$= \boxed{1m}$
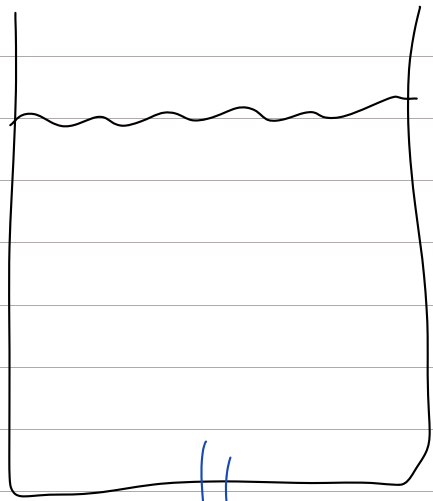
용액 1kg $\Rightarrow$ 포도당+물

$\rightarrow$ 포도당 = $\boxed{180g}$
물 = 820g.

$m = \dfrac{1mol}{0.82kg}$

$= \boxed{}?$
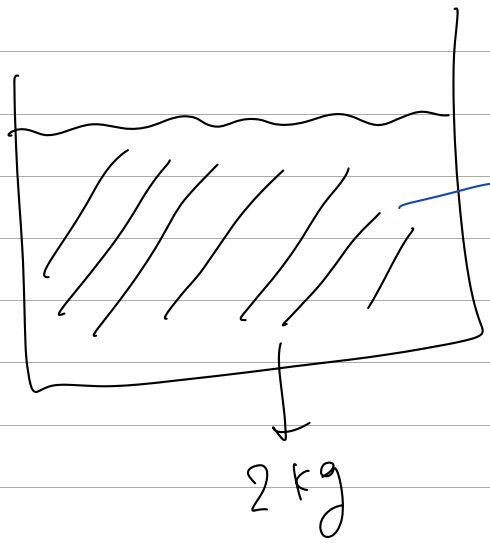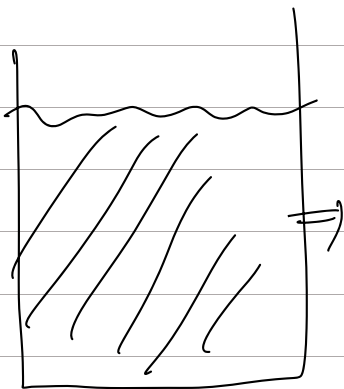
$\rightarrow$ 포도당 150g

2kg

$\dfrac{150g}{2000g} \times 100 = \boxed{} \cdot \%$

(퍼센트농도)
질량퍼센트

✗ 노르말농도

i) Na^+ , O^{2-} , Al^{3+}

$1mol = 3 eq$

$1mol = 1eq$ $1mol = 2eq$

ii) HCl (H^+ + Cl^-)

$1mol = 1 eq = 1N$

H_2SO_4 ($2H^+$ + SO_4^{2-})

$1mol = 2eq = 2N$

NaOH (Na^+ + OH^-)

$1mol = 1eq = 1N$

$Mg(OH)_2$ (Mg^{2+} + $2OH^-$)

$1mol = 2eq = 2N$

용질 + 용매

$\downarrow$ 총 10mol
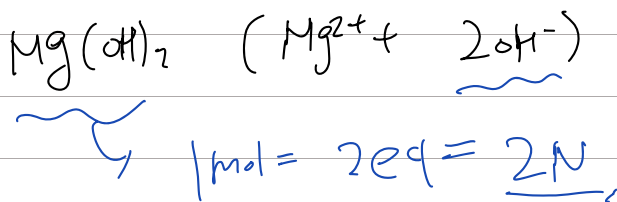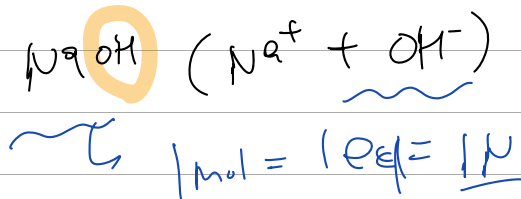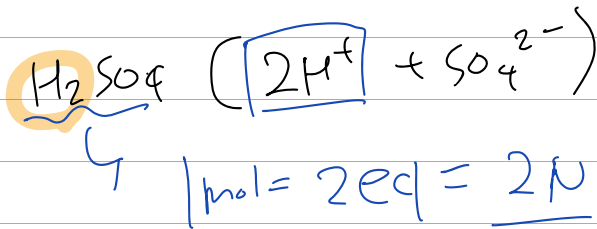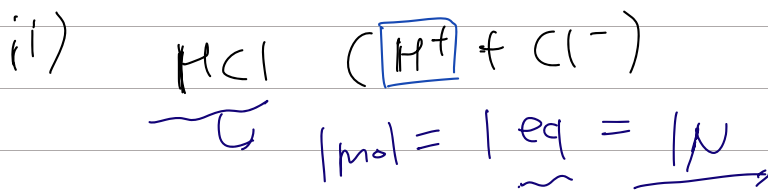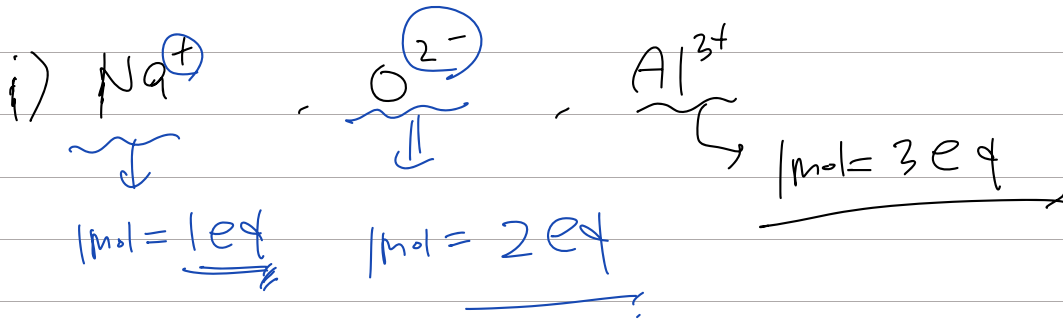
표준당 2mol

$$X_{H_2O} = \frac{n_{H_2O}}{n_{H_2O} + n_{C_6H_{12}O_6}} = \boxed{\frac{10}{12}}$$

$$X_{C_6H_{12}O_6} = \frac{n_{C_6H_{12}O_6}}{n_{H_2O} + n_{C_6H_{12}O_6}}$$

$$= \boxed{\frac{2}{12}}$$

$\Rightarrow$ 몰 분율 모두 더하면 $\Rightarrow$ ①

$$\sum_{j=1}^{N} x_j = 1 = x_1 + x_2 + \cdots + x_N = \underline{1}$$

$$(1, 2, 3, 4 \cdots, N)$$

예제 1)

$$M = \frac{n}{V} = \frac{\left(\boxed{48.5g \Big/ 58.5g/mol} \right)^{n_{NaCl}}}{2.5L} = \underline{0.332M}$$

예제 2)

$$\left[Ba(NO_3)_2 \rightarrow Ba^{2+} + 2NO_3^- \right]$$

$$\qquad\quad 1 \qquad\qquad\qquad\qquad 2$$
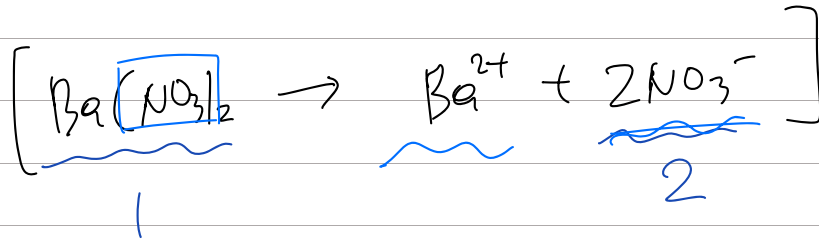
$\Rightarrow \quad n_{Ba(NO_3)_2} = M \cdot V = \left(1 \times 10^{-3} M \right) \left(1.5L \right)$

$$= \boxed{1.5 \times 10^{-3} mol}$$

$\Rightarrow \quad 1.5 \times 10^{-3} mol \; Ba(NO_3)_2 \times \dfrac{2 mol \; NO_3^-}{1 mol \; Ba(NO_3)_2}$

$$= 3.0 \times 10^{-3} mol \; NO_3^-$$

예제3)

$$M, V, n$$

$$M = 1.50 \, M$$

$$n = \frac{1 \times 10^{-3} \, g}{58.5 \, g/mol} = 1.7 \times 10^{-5} \, mol \, NaCl$$

$$M = \frac{n}{V}, \quad V = \frac{n}{M} = \frac{(1.7 \times 10^{-5} \, mol)}{(0.15 \, M)}$$

$$= 1.1 \times 10^{-4} \, L$$

예제4)

① $M = 0.25 \, M$

② $n_{AgNO_3} = \left(\frac{10 g}{169.99 \, g/mol} \right) mol$

$$M = \frac{n}{V}, \quad V = \frac{n}{M} = \frac{(10 g / (169.99 \, g/mol))}{(0.25 \, M)}$$

$$= \boxed{0.24 \, L}$$

예제 5) $n_{HCl} = M \cdot V = (0,1M)(1,25L)$

$$= \boxed{0,125\,mol}$$

$$\boxed{M = 10M}$$

$\leadsto V = \dfrac{n}{M} = \dfrac{0,125\,mol}{10\,M} = \underline{0,0125\,L}$

예제 6)

$H_2O \Rightarrow \boxed{200\,g}$ ∅

$MgCl_2 \Rightarrow 22,4\,g$ $\Rightarrow$ 222,4g

$\rho = \dfrac{m}{V}$, $m = \rho V$

$= (1g/cm^3)(200cm^3)$

$= 200\,g$

i) $\chi_{MgCl_2} = \dfrac{n_{MgCl_2}}{n_{H_2O} + n_{MgCl_2}}$

$$= \dfrac{\left(\dfrac{22,4\,g}{95,3\,g/mol}\right)}{\left(\dfrac{200g}{18g/mol}\right) + \left(\dfrac{22,4g}{95,3g/mol}\right)}$$

$0,235$

$= 0,020\eta$

$11,1 = $ ... $= 0,235$

ii) $M = \dfrac{n}{\boxed{V}} = \dfrac{0.235\,mol}{0.2042\,L} = \underline{1.15\,M}$

$\rho = \dfrac{m}{V}, \quad V = \dfrac{m}{\rho} = \dfrac{222.4\,g}{(1.089\,g/cm^3)} = 204.2\,cm^3$

$= 0.2042\,L$

iii) $m = \dfrac{n}{kg} = \dfrac{0.235\,mol}{0.2\,kg} = \underline{1.18\,m}$

예제 7) $9.386\,M \Rightarrow$ 용액 $1L$ 안에 H_2SO_4 $\underline{9.386\,mol}$
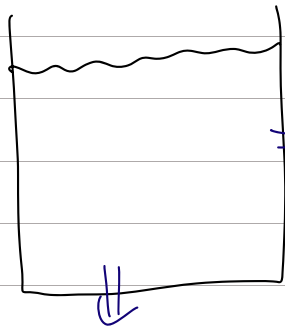
$\dfrac{\rho}{\ } \Rightarrow (1509.1 - 919.8)\,g = \underline{589.3\,g}$

$\rightarrow \dfrac{589.3\,g}{18\,g/mol} = \underline{32.73\,mol}$

황산 $\Rightarrow 9.386\,mol$

$(9.386\,mol)(98\,g/mol) = \underline{919.8\,g}$

$\rho = \dfrac{m}{V}, \quad m = \rho V = (1.509\,g/cm^3)(1000\,cm^3)$

$= 1509.1\,g$

i) $m = \dfrac{n_{H_2SO_4}}{kg\,(용매)} = \dfrac{9.386\,mol}{0.5893\,kg} = \underline{15.92\,m}$

ii) $\% = \dfrac{919.8\,g}{1509.1\,g} \times 100 = \underline{61\,\%}$

iii) $X_{H_2SO_4} = \dfrac{(9.386\,mol)}{(32.113\,mol) + (9.386\,mol)}$

$$= 0.223$$

예제 8)

a) 0.1M $KHCO_3$ ≓ 0.5L

$n = M \cdot V = (0.1M)(0.5L) = 0.05\,mol\ KHCO_3$

→ 0.5L의 물에 $KHCO_3$ 0.05 mol을 넣는다

b) $KHCO_3 = \boxed{0.05\,mol}$ ≓ 일정!

$M = \dfrac{mol}{L}$ $V = \dfrac{mol}{M} = \dfrac{0.05\,mol}{0.04M}$

$$= \boxed{1.25L}$$

≓ a)의 수용액에 0.75L를 추가한다

예제1)

$$HCl \rightarrow H^+ + Cl^-$$

$$KOH \rightarrow K^+ + OH^-$$

$$HCl + KOH \rightarrow H_2O + KCl$$
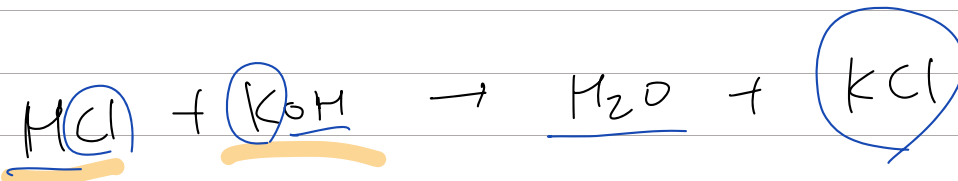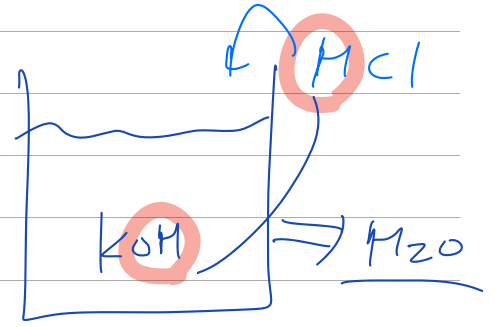
I	0.0125 mol	0.0125 mol		
C	−0.0125 mol	−0.0125 mol	+0.0125 mol	+0.0125 mol
E				

$$n_{KOH} = (0.25M)(0.045L) = 0.0125 \, mol$$

$$(0.25M)(45mL) = 11.25 \, mmol$$

$$M = \frac{n}{V}, \quad V = \frac{n}{M} = \frac{0.0125 \, mol}{0.2M} = 0.05625 L$$
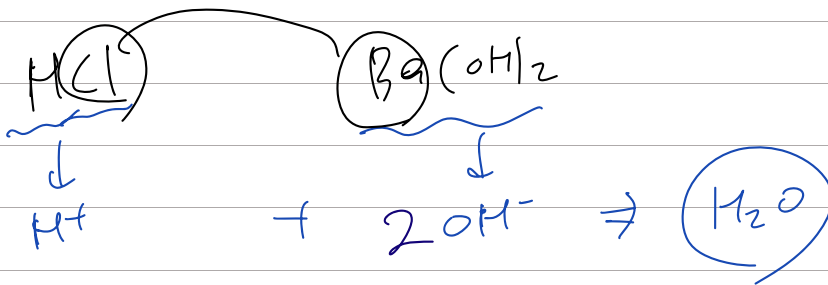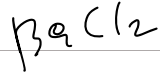
$$x = \frac{(0.045)(0.25)}{(0.2)}$$

$$\eta = \boxed{MV} \quad\Rightarrow\quad M_{HCl}V_{HCl} = M_{KOH}V_{KOH}$$
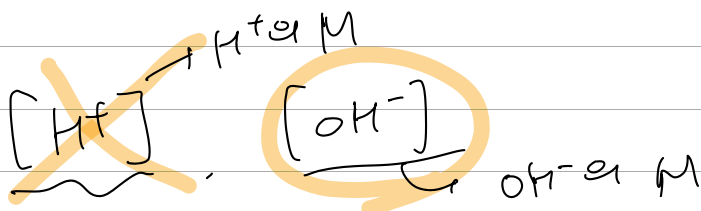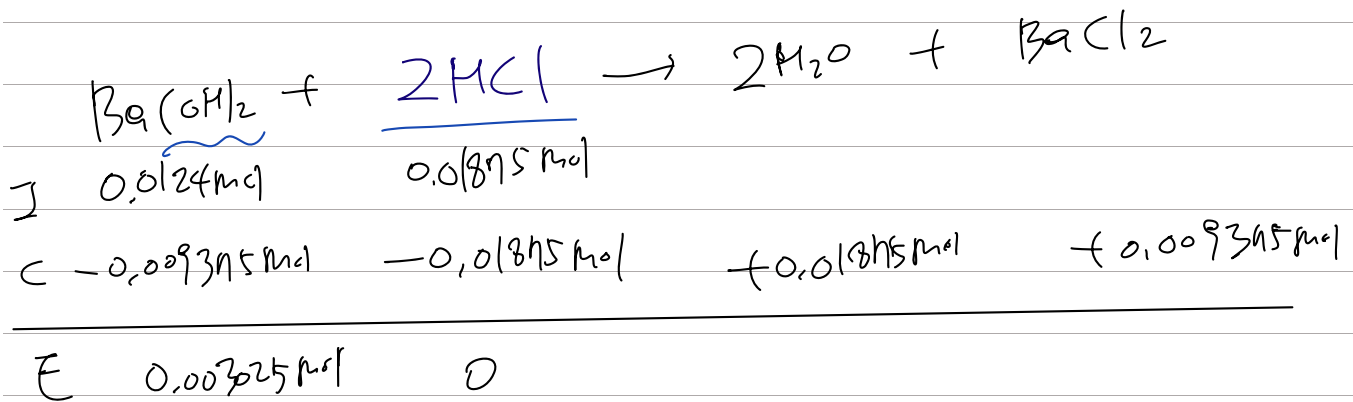
KOH, HCl

$$V_{HCl} = \frac{M_{KOH}V_{KOH}}{M_{HCl}}$$
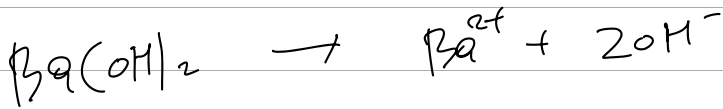
$$= \frac{(0.045)(0.25)}{0.2}$$

예제 2)

$BaCl_2$

HCl $Ba(OH)_2$

$\underset{H^+}{\downarrow} \qquad + \quad 2OH^- \quad\Rightarrow\quad \boxed{H_2O}$

$$\eta_{Ba(OH)_2} = (0.225C)(0.055M) = \underline{0.0124\ mol}$$

$$\eta_{HCl} = (0.25M)(0.075C) = \underline{0.01875\ mol}$$

$$Ba(OH)_2 + \underline{2HCl} \longrightarrow 2H_2O + BaCl_2$$

	$Ba(OH)_2$	$2HCl$	$2H_2O$	$BaCl_2$
I	$0.0124\,mol$	$0.01875\,mol$		
C	$-0.009375\,mol$	$-0.01875\,mol$	$+0.01875\,mol$	$+0.009375\,mol$
E	$0.003025\,mol$	0		

$\cancel{[H^+]}$, $\underset{\text{OH}^-\text{의 M}}{\boxed{[OH^-]}}$ ← H^+의 M

$$Ba(OH)_2 \longrightarrow Ba^{2+} + 2OH^-$$

$$I \quad 0.003025 mol$$

$$C \quad -0.003025 \qquad +0.003025 \qquad \boxed{0.00605}$$

$$E$$

$$n_{OH^-} = 0.00605 mol \qquad V = 0.3L$$

$$M \Rightarrow [OH^-] = \frac{n_{OH^-}}{V} = \frac{0.00605 mol}{0.3L} = \boxed{0.02M}$$

예제 3/

$$\boxed{NaOH} \rightarrow OH^-$$

$$\boxed{HCl} \Rightarrow H^+$$
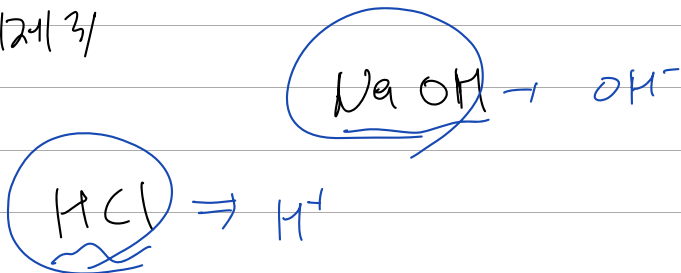
$$n_{NaOH} = (0.106M)(0.02416L) = \underline{2.56 \times 10^{-3} mol}$$

$$n_{HCl} = \frac{2.56 \times 10^{-3} mol}{}$$

$$HCl + NaOH \longrightarrow H_2O + NaCl$$
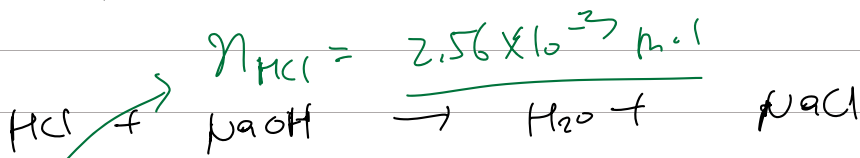
$$I \quad 2.56 \times 10^{-3}$$

$$C \quad -2.56 \times 10^{-3} mol \quad -2.56 \times 10^{-3} mol$$

$$E$$

$$[HCl] = \frac{n}{V} = \frac{(2.56 \times 10^{-3} mol)}{(0.025L)} = \underline{0.102M}$$

예제 4) $\begin{bmatrix} K_a = 1.8 \times 10^{-5} \\ K_b = 5.6 \times 10^{-10} \end{bmatrix}$ ⑧

$O_2 = 100$

$$CH_3COOH \longrightarrow \boxed{CH_3COO^-} + \boxed{H^+}$$

$$NaOH \longrightarrow \boxed{Na^+} + \boxed{OH^-} = \boxed{H_2O}$$

$$CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$$
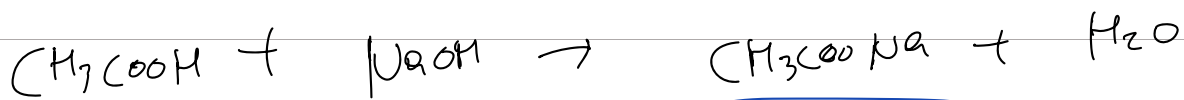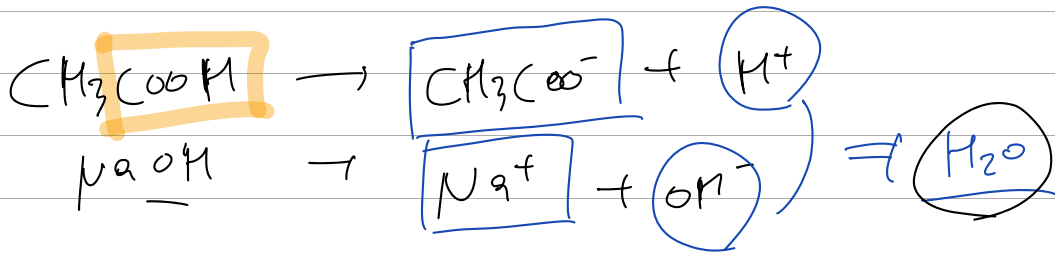
I	$4.135 \times 10^{-2} \, mol$	$4.135 \times 10^{-2} \, mol$
C	$-4.135 \times 10^{-2} \, mol$	$-4.135 \times 10^{-2} \, mol$
E		

$n_{CH_3COOH} = 4.135 \times 10^{-2} \, mol$

$n_{NaOH} = (1.306 M)(0.03166 \, L) = 4.135 \times 10^{-2} \, mol$
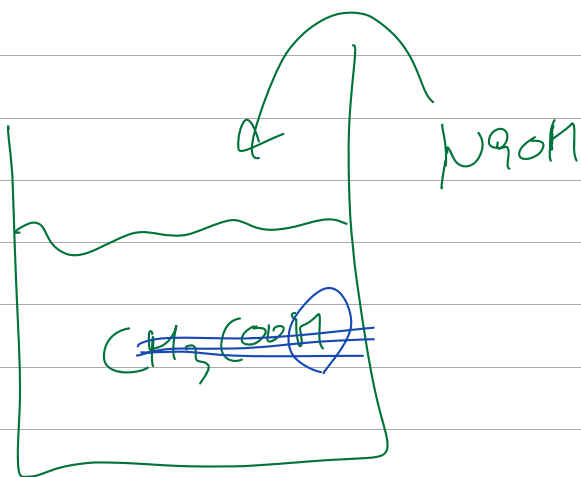
$[CH_3COOH] = \dfrac{4.135 \times 10^{-2} \, mol}{0.05 \, L}$

$= 0.827 \, M$

$$Ba(NO_3)_2 \rightarrow Ba^{2+} + 2NO_3^-$$

예제 1)

$$AgNO_3 \rightarrow \boxed{Ag^+} + NO_3^-$$

$$NaCl \rightarrow Na^+ + \boxed{Cl^-} \Rightarrow \underline{AgCl}$$

$$AgNO_3 + NaCl \rightarrow \underline{AgCl} + NaNO_3$$
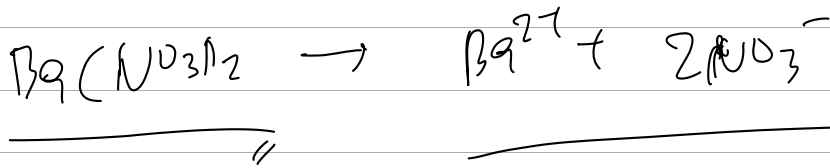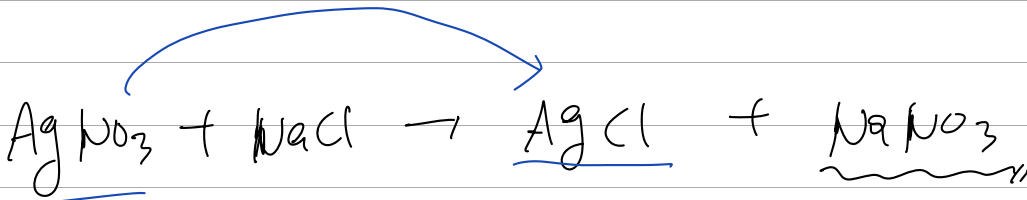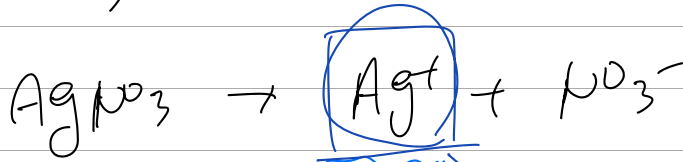
I : 0.5mol   0.5mol

C : −0.5mol   −0.5mol

E :

$$n_{AgNO_3} = (0.2M)(2.5L) = \underline{0.5mol}$$

$$\Rightarrow \text{필요한 } n_{NaCl} = 0.5mol$$

$$\rightarrow W_{NaCl} = (0.5mol)(58.5 g/mol)$$

$$= \underline{29.2g}$$

예제 2)

$$KOH \longrightarrow K^+ + \boxed{OH^-} \Longrightarrow Mg(OH)_2$$

$$Mg(NO_3)_2 \longrightarrow \boxed{Mg^{2+}} + 2NO_3^-$$

$$2KOH + Mg(NO_3)_2 \longrightarrow \boxed{Mg(OH)_2} + 2KNO_3$$
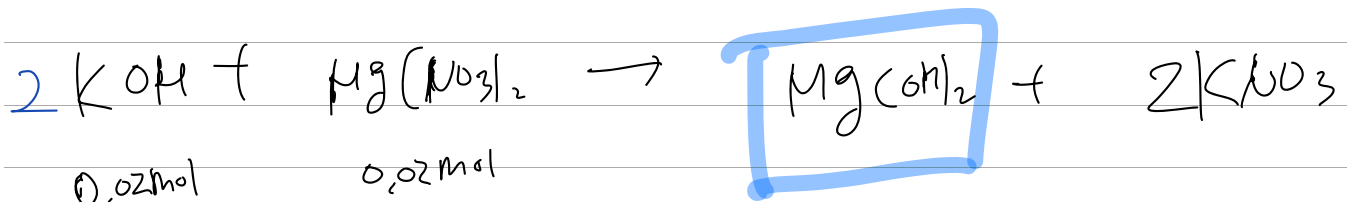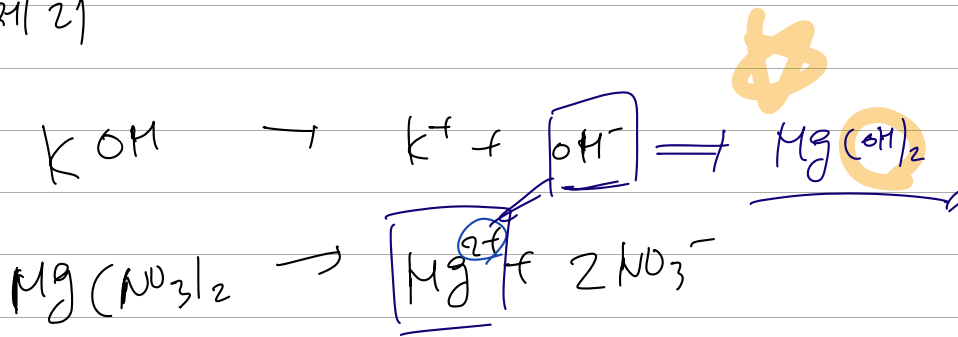
	$2KOH$	$Mg(NO_3)_2$	$Mg(OH)_2$	$2KNO_3$
I	0.02mol	0.02mol		
C	-0.02	-0.01	+0.01	+0.02
E	0	0.01	0.01	0.02

$$n_{KOH} = (0.2M)(0.1L) = 0.02mol \ KOH$$

$$n_{Mg(NO_3)_2} = (0.2M)(0.1L) = 0.02 \ mol \ Mg(NO_3)_2$$

$$W_{Mg(OH)_2} = (0.01 \ mol)(58 \ g/mol) = 0.58 \ g$$

예제 3)

$$Na_2CO_3 \rightarrow 2Na^+ + CO_3^{2-} \rightleftharpoons CaCO_3$$

$$CaCl_2 \rightarrow Ca^{2+} + 2Cl^- \rightarrow 2NaCl$$

$$Na_2CO_3 + CaCl_2 \rightarrow CaCO_3 + 2NaCl$$

$$\hookrightarrow Ca^{2+} + CO_3^{2-} \rightarrow CaCO_3$$

$$\left(\overset{\text{알}}{\text{알짜이온반응식}} \right)$$

$$H^+ + OH^- \rightarrow H_2O$$
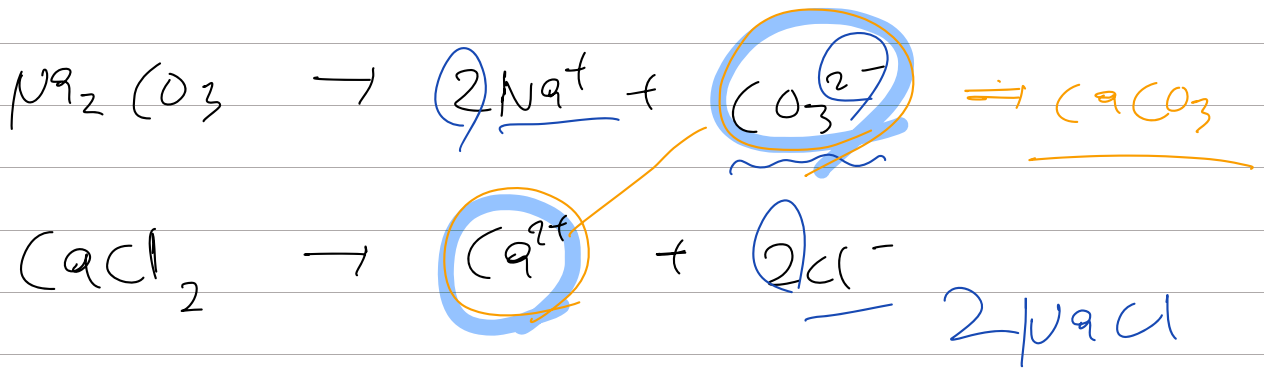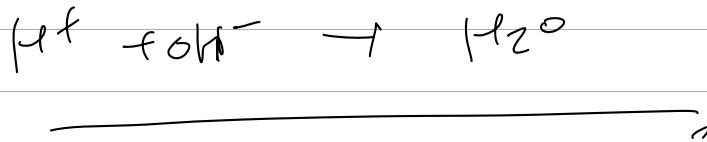
예제 4) $n_{K_2Cr_2O_7} = \dfrac{6.2g}{294.2g/mol} = 0.021 \, mol$

$$K_2Cr_2O_n + 14HCl \rightarrow 2K^+ + 2Cr^{3+} + 8Cl^- + 7H_2O + 3Cl_2$$

I   0.0211 mol
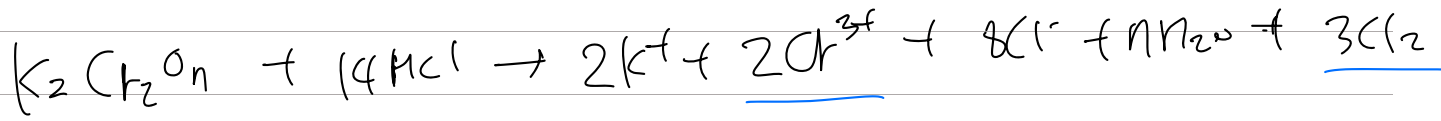
C   -0.0211 mol   +0.0422 mol   0.0633 mol
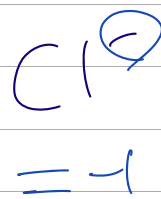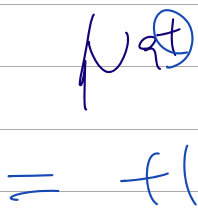
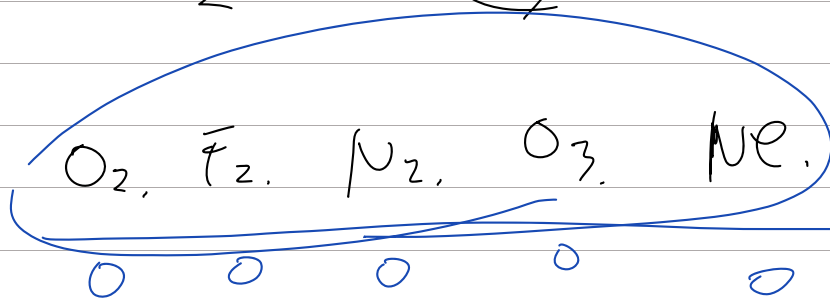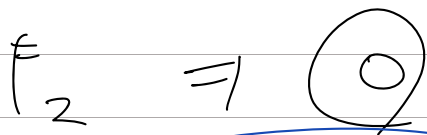E   0.0422 mol   0.0633 mol

$$n\ Cl_2 = 0.0633\ mol$$

$$[Cr^{3+}] = \frac{0.0422\ mol}{0.1\ L} = 0.422\ M$$

$$Na^\oplus \qquad\qquad Cl^\ominus \qquad\qquad Mg^{2\oplus}$$
$$= +1 \qquad\qquad = -1 \qquad\qquad = +2$$

$$Al^{3\oplus}$$
$$+3$$

$$NH_3 \begin{cases} (-3) \\ (+1)\times 3 \end{cases} (=0)$$

$$NH_4^\oplus \begin{cases} (-3) \\ (+1)\times 4 \end{cases} (+1)$$

$F_2 \;=\! \bigcirc$

$O_2, \; F_2, \; N_2, \; O_3, \; Ne, \; \cdots$

$\left(F^{\ominus} \right.$

$\left.\text{금속원소} \quad 개 > 0 \right)$

$\quad\quad\quad$ 알알자/알칼자토

$\quad\quad\quad$ 1쪽12쪽

a) $\quad N_2 \, \vdots \, O$

$\quad (+1) \, \vert \, (-2)$

f) $\quad O \, \vdots \, F_2$

$\quad (+2) \, \vdots \, (-1) \times 2$

$\nearrow$ 초과산화물

b) $\quad Cl O^{\ominus}$

$\quad (+1) \, \vdots \, (-2) = -1$

g) $\quad K \, \vdots \, O_2$ $\quad$ 평균산화수

$\quad (+1) \, \vert \, \left(-\frac{1}{2}\right) \times 2$ $\quad \begin{array}{cc} -1 & \vdots & 1 \\ 0 & \vdots & 1 \end{array}$

$\quad\quad\quad \boxed{-\frac{1}{2}}$

c) $\quad SO_4^{\,2-}$

$\quad (+6) \, \vdots \, (-2)$

h) $\quad Pb \, \vdots \, O$

$\quad (+2) \, \vdots \, (-2)$

d) $\quad \cancel{B} \, Mn \, \vdots \, O_4$

$\quad (+1) \,\, (+7) \, \vert \, (-2)$

I) $\quad Pb \, \vdots \, O_2$

$\quad (+4) \, \vdots \, (-2)$

e) $\quad H_2 \, \vdots \, O_2$

$\quad (+1) \, \vdots \, (-1)$

j) $\quad Pb_2 \, \vdots \, O_3$

$\quad (+3) \, \vdots \, (-2)$

$\quad\quad \begin{bmatrix} Pb & +2 \\ Pb & +4 \end{bmatrix}$

k) Fe_3O_4

$\left(+\dfrac{8}{3}\right)$ (-2)

Fe $+2$ $\times 1$
Fe $+3$ $\times 2$ $\Big] = \dfrac{8}{3}$

l) $\overset{+4}{Ba}$ $\overset{-2}{O_2}$

$(+2)$ $(-1\times 2) = 0$

$\Big($ Li, Be, Na, Mg, K, Ca, Cs, Rb. $\Big)$

1족, 2족 (알칼리 / 알칼리 토)

예제 2

MnO_2 + $4HCl$ → $MnCl_2$ + $2H_2O$ + Cl_2
$(+4)(-2)$ $(+1)(-1)$ $(+2)(-1)$ $(+1)(-2)$ (0)

⇒ 산화수 증가 : Cl (산)

⇒ 감소 : Mn (환)

예제 3/ Ⓕ / Cl. Br. I (-1)

$$Sn\ Cl_2 \quad + Cl_2 \quad \to \quad Sn\ Cl_4$$
$$(+2)\ (-1) \qquad (0) \qquad\qquad (+4)\ (-1)$$

$$Ca\ CO_3 \quad \to \quad CaO \quad + \quad CO_2$$
$$(+2)(+4)(-2) \qquad (+2)\ (-2) \qquad (+4)\ (-2)$$

$$2H_2O_2 \quad \to \quad 2H_2O \quad + \quad O_2$$
$$(+1)\ (-1) \qquad\qquad (+1)\ (-2) \qquad (0)$$