

2005년~2013년 필답 · 작업형 반응식 정리 (네이버 산업안전카페)

* 분말소화약제의 반응식 - [미정계수법 동영상 보기](#) (◀클릭 동영상으로 이동)

종별	주성분	색상	적용화재	반응식	
제1종분말	중탄산나트륨(NaHCO ₃)	백색	BC화재	270℃ 분해식	2NaHCO ₃ → Na ₂ CO ₃ + CO ₂ + H ₂ O (중탄산나트륨) (탄산나트륨) (이산화탄소) (물)
				850℃ 분해식	2NaHCO ₃ → Na ₂ O + 2CO ₂ + H ₂ O (중탄산나트륨) (산화나트륨) (이산화탄소) (물)
제2종분말	중탄산칼륨(KHCO ₃)	보라색	BC화재	2KHCO ₃ → K ₂ CO ₃ + CO ₂ + H ₂ O (중탄산칼륨) (탄산칼륨) (이산화탄소) (물)	
제3종분말	인산암모늄(NH ₄ H ₂ PO ₄)	담홍색	ABC화재	1차 분해식	NH ₄ H ₂ PO ₄ → H ₃ PO ₄ + NH ₃ (인산암모늄) (올포인산) (암모니아)
				2차 분해식	NH ₄ H ₂ PO ₄ → HPO ₃ + NH ₃ + H ₂ O (인산암모늄) (메타인산) (암모니아) (물)

* 화학포반응식 : 6NaHCO₃ + Al₂(SO₄)₃·18H₂O → 3Na₂SO₄ + 2Al(OH)₃ + 6CO₂ + 18H₂O
(탄산수소나트륨) (황산알루미늄) (황산나트륨) (수산화알루미늄) (이산화탄소) (물)

NO	품명	출제횟수	반응식
1	과망간산칼륨 + 염산	1	2KMnO ₄ + 16HCl → 2KCl + 2MnCl ₂ + 8H ₂ O + 5Cl ₂ (과망간산칼륨) (염산) (염화칼륨) (염화망간) (물) (염소)
2	과망간산칼륨 + 황산	3	4KMnO ₄ + 6H ₂ SO ₄ → 2K ₂ SO ₄ + 4MnSO ₄ + 6H ₂ O + 5O ₂ (과망간산칼륨) (황산) (황산칼륨) (황산망간) (물) (산소)
3	과망간산칼륨 열분해식	4	2KMnO ₄ → K ₂ MnO ₄ + MnO ₂ + O ₂ (과망간산칼륨) (망간산칼륨) (이산화망간) (산소)
4	과산화나트륨 + 물	2	2Na ₂ O ₂ + 2H ₂ O → 4NaOH + O ₂ (과산화나트륨) (물) (수산화나트륨) (산소)
5	과산화나트륨 + 이산화탄소	1	2Na ₂ O ₂ + 2CO ₂ → 2Na ₂ CO ₃ + O ₂ (과산화나트륨) (이산화탄소) (탄산나트륨) (산소)
6	과산화바륨 + 물	1	2BaO ₂ + 2H ₂ O → 2Ba(OH) ₂ + O ₂ (과산화바륨) (물) (수산화바륨) (산소)
7	과산화바륨 + 염산	1	BaO ₂ + 2HCl → BaCl ₂ + H ₂ O ₂ (과산화바륨) (염산) (염화바륨) (과산화수소)
8	과산화바륨 + 황산	1	BaO ₂ + H ₂ SO ₄ → BaSO ₄ + H ₂ O ₂ (과산화바륨) (황산) (황산바륨) (과산화수소)
9	과산화수소 + 히드라진	2	2H ₂ O ₂ + N ₂ H ₄ → 4H ₂ O + N ₂ (과산화수소) (히드라진) (물) (질소)
10	과산화수소 분해식	1	2H ₂ O ₂ → 2H ₂ O + O ₂ (과산화수소) (물) (산소)
11	과산화칼륨 + 물	2	2K ₂ O ₂ + 2H ₂ O → 4KOH + O ₂ (과산화칼륨) (물) (수산화칼륨) (산소)
12	과염소산 분해식	2	HClO ₄ → HCl + 2O ₂ (과염소산) (염산) (산소)
13	과염소산나트륨 + 염화칼륨	1	NaClO ₄ + KCl → KClO ₄ + NaCl (과염소산나트륨) (염화칼륨) (과염소산칼륨) (염화나트륨)
14	과염소산칼륨 610℃열분해식	1	KClO ₄ → KCl + 2O ₂ (과염소산칼륨) (염화칼륨) (산소)
15	구리 + 진한질산	1	Cu + 4HNO ₃ → Cu(NO ₃) ₂ + 2NO ₂ + 2H ₂ O (구리) (진한질산) (질산구리) (이산화질소) (물)
16	나트륨 + 물	3	2Na + 2H ₂ O → 2NaOH + H ₂ (나트륨) (물) (수산화나트륨) (수소)
17	나트륨 + 에탄올	1	2Na + 2C ₂ H ₅ OH → 2C ₂ H ₅ ONa + H ₂ (나트륨) (에탄올) (나트륨에틸레이트) (수소)
18	나트륨 + 이산화탄소	1	4Na + 3CO ₂ → 2Na ₂ CO ₃ + C (나트륨) (이산화탄소) (탄산나트륨) (탄소)
19	나트륨 연소식	1	4Na + O ₂ → 2Na ₂ O (나트륨) (산소) (산화나트륨)
20	니트로글리세린 열분해식	1	4C ₃ H ₅ (ONO ₂) ₃ → 12CO ₂ + 6N ₂ + O ₂ + 10H ₂ O (니트로글리세린) (이산화탄소) (질소) (산소) (물)
21	니트로글리세린 제조	2	C ₃ H ₅ (OH) ₃ + 3HNO ₃ $\xrightarrow{C-H_2SO_4}$ C ₃ H ₅ (ONO ₂) ₃ + 3H ₂ O (글리세린) (질산) (니트로글리세린) (물)

22	니트로벤젠 제조	1	$\text{C}_6\text{H}_6 + \text{HNO}_3 \xrightarrow[\text{니트로화}]{\text{C-H}_2\text{SO}_4} \text{C}_6\text{H}_5\text{NO}_2 + \text{H}_2\text{O}$ (벤젠) (질산) (니트로벤젠) (물)
23	디에틸에테르 제조	3	$2\text{C}_2\text{H}_5\text{OH} \xrightarrow{\text{C-H}_2\text{SO}_4} \text{C}_2\text{H}_5\text{OC}_2\text{H}_5 + \text{H}_2\text{O}$ (에틸알코올) (디에틸에테르) (물)
24	마그네슘 + 물	2	$\text{Mg} + 2\text{H}_2\text{O} \rightarrow \text{Mg}(\text{OH})_2 + \text{H}_2$ (마그네슘) (온수) (수산화마그네슘) (수소)
25	마그네슘 + 염산	1	$\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$ (마그네슘) (염산) (염화마그네슘) (수소)
26	마그네슘 + 이산화탄소	1	$2\text{Mg} + \text{CO}_2 \rightarrow 2\text{MgO} + \text{C}$ (마그네슘) (이산화탄소) (산화마그네슘) (탄소)
27	마그네슘 + 황산	1	$\text{Mg} + \text{H}_2\text{SO}_4 \rightarrow \text{MgSO}_4 + \text{H}_2$ (마그네슘) (황산) (황산마그네슘) (수소)
28	마그네슘 연소식	1	$2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$ (마그네슘) (산소) (산화마그네슘)
29	메탄 분해식	1	$\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$ (메탄) (산소) (이산화탄소) (물)
30	메탄올(에틸알코올) 연소식	1	$2\text{CH}_3\text{OH} + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 4\text{H}_2\text{O}$ (메틸알코올) (산소) (이산화탄소) (물)
31	메틸리튬 + 물	1	$(\text{CH}_3)\text{Li} + \text{H}_2\text{O} \rightarrow \text{LiOH} + \text{CH}_4$ (메틸리튬) (물) (수산화리튬) (메탄)
32	삼산화크롬 + 물	1	$\text{CrO}_3 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CrO}_4$ (삼산화크롬) (물) (크롬산)
33	삼산화크롬 열분해식	2	$4\text{CrO}_3 \rightarrow 2\text{Cr}_2\text{O}_3 + 3\text{O}_2$ (삼산화크롬) (산화크롬) (산소)
34	삼황화린 연소식	2	$\text{P}_4\text{S}_3 + 8\text{O}_2 \rightarrow 2\text{P}_2\text{O}_5 + 3\text{SO}_2$ (삼황화린) (산소) (오산화린) (이산화황)
35	수소화알루미늄리튬 + 물	1	$\text{LiAlH}_4 + 4\text{H}_2\text{O} \rightarrow \text{LiOH} + \text{Al}(\text{OH})_3 + 4\text{H}_2$ (수소화알루미늄리튬) (물) (수산화리튬) (수산화알루미늄) (수소)
36	수소화칼륨 + 물	1	$\text{KH} + \text{H}_2\text{O} \rightarrow \text{KOH} + \text{H}_2$ (수소화칼륨) (물) (수산화칼륨) (수소)
37	아세톤 연소식	1	$\text{CH}_3\text{COCH}_3 + 4\text{O}_2 \rightarrow 3\text{CO}_2 + 3\text{H}_2\text{O}$ (아세톤) (산소) (이산화탄소) (물)
38	아세트산 + 과산화나트륨	1	$2\text{CH}_3\text{COOH} + \text{Na}_2\text{O}_2 \rightarrow 2\text{CH}_3\text{COONa} + \text{H}_2\text{O}_2$ (아세트산) (과산화나트륨) (아세트산나트륨) (과산화수소)
39	아세트산 연소식	1	$\text{CH}_3\text{COOH} + 2\text{O}_2 \rightarrow 2\text{CO}_2 + 2\text{H}_2\text{O}$ (아세트산) (산소) (이산화탄소) (물)
40	아세트알데히드 산화식	1	$\text{CH}_3\text{CHO} + \frac{1}{2}\text{O}_2 \rightarrow \text{CH}_3\text{COOH}$ (아세트알데히드) (산소) (초산)
41	아세틸렌 + 구리	2	$\text{C}_2\text{H}_2 + 2\text{Cu} \rightarrow \text{Cu}_2\text{C}_2 + \text{H}_2$ (아세틸렌) (구리) (구리아세틸리드) (수소)
42	아세틸렌 연소식	4	$2\text{C}_2\text{H}_2 + 5\text{O}_2 \rightarrow 4\text{CO}_2 + 2\text{H}_2\text{O}$ (아세틸렌) (산소) (이산화탄소) (물)
43	아연 + 염산	1	$\text{Zn} + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2$ (아연) (염산) (염화아연) (수소)
44	아연 + 황산	1	$\text{Zn} + \text{H}_2\text{SO}_4 \rightarrow \text{ZnSO}_4 + \text{H}_2$ (아연) (황산) (황산아연) (수소)
45	아염소산나트륨 + 알루미늄	1	$3\text{NaClO}_2 + 4\text{Al} \rightarrow 2\text{Al}_2\text{O}_3 + 3\text{NaCl}$ (아염소산나트륨) (알루미늄) (산화알루미늄) (염화나트륨)
46	알루미늄 + 물	1	$2\text{Al} + 6\text{H}_2\text{O} \rightarrow 2\text{Al}(\text{OH})_3 + 3\text{H}_2$ (알루미늄) (물) (수산화알루미늄) (수소)
47	알루미늄 연소식	1	$4\text{Al} + 3\text{O}_2 \rightarrow 2\text{Al}_2\text{O}_3$ (알루미늄) (산소) (산화알루미늄)
48	에탄올(에틸알코올) + 칼륨	1	$2\text{C}_2\text{H}_5\text{OH} + 2\text{K} \rightarrow 2\text{C}_2\text{H}_5\text{OK} + \text{H}_2$ (에틸알코올) (칼륨) (칼륨에틸레이트) (수소)
49	에탄올(에틸알코올) 연소식	2	$\text{C}_2\text{H}_5\text{OH} + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 3\text{H}_2\text{O}$ (에틸알코올) (산소) (이산화탄소) (물)
50	에틸렌 산화식	1	$\text{C}_2\text{H}_4 + \text{PdCl}_2 + \text{H}_2\text{O} \rightarrow \text{CH}_3\text{CHO} + \text{Pd} + 2\text{HCl}$ (에틸렌) (염화팔라듐) (물) (아세트알데히드) (팔라듐) (염산)
51	염산 + 질산은	1	$\text{HCl} + \text{AgNO}_3 \rightarrow \text{HNO}_3 + \text{AgCl}$ (염산) (질산은) (질산) (염화은)

52	염소산칼륨 + 황산	2	$6\text{KClO}_3 + 3\text{H}_2\text{SO}_4 \rightarrow 2\text{HClO}_4 + 3\text{K}_2\text{SO}_4 + 4\text{ClO}_2 + 2\text{H}_2\text{O}$ (염소산칼륨) (황산) (과염소산) (황산칼륨) (이산화염소) (물)
53	염소산칼륨 400℃ 열분해식	2	$2\text{KClO}_3 \rightarrow \text{KCl} + \text{KClO}_4 + \text{O}_2$ (염소산칼륨) (염화칼륨) (과염소산칼륨) (산소)
54	염소산칼륨 540~560℃ 열분해식	2	$2\text{KClO}_3 \rightarrow 2\text{KCl} + 3\text{O}_2$ (염소산칼륨) (염화칼륨) (산소)
55	오황화린 + 물	1	$\text{P}_2\text{S}_5 + 8\text{H}_2\text{O} \rightarrow 2\text{H}_3\text{PO}_4 + 5\text{H}_2\text{S}$ (오황화린) (물) (올소인산) (황화수소)
56	이산화망간 + 과산화수소	1	$\text{MnO}_2 + 2\text{H}_2\text{O}_2 \rightarrow \text{MnO}_2 + 2\text{H}_2\text{O} + \text{O}_2$ (이산화망간) (과산화수소) (이산화망간) (물) (산소) * 이산화망간은 촉진제 역할만하고 반응 후 바닥에 그대로 남아 있다.
57	이황화탄소 + 물	2	$\text{CS}_2 + 2\text{H}_2\text{O} \rightarrow 2\text{H}_2\text{S} + \text{CO}_2$ (이황화탄소) (물) (황화수소) (이산화탄소)
58	이황화탄소 연소식	1	$\text{CS}_2 + 3\text{O}_2 \rightarrow 2\text{SO}_2 + \text{CO}_2$ (이황화탄소) (산소) (이산화황) (이산화탄소)
59	인화알루미늄 + 물	2	$\text{AlP} + 3\text{H}_2\text{O} \rightarrow \text{Al}(\text{OH})_3 + \text{PH}_3$ (인화알루미늄) (물) (수산화알루미늄) (포스핀)
60	인화칼슘 + 물	3	$\text{Ca}_3\text{P}_2 + 6\text{H}_2\text{O} \rightarrow 3\text{Ca}(\text{OH})_2 + 2\text{PH}_3$ (인화칼슘) (물) (수산화칼슘) (포스핀)
61	적린 연소식	1	$4\text{P} + 5\text{O}_2 \rightarrow 2\text{P}_2\text{O}_5$ (적린) (산소) (오산화린)
62	중크롬산칼륨 열분해식	2	$4\text{K}_2\text{Cr}_2\text{O}_7 \rightarrow 2\text{Cr}_2\text{O}_3 + 4\text{K}_2\text{CrO}_4 + 3\text{O}_2$ (중크롬산칼륨) (산화크롬) (크롬산칼륨) (산소)
63	질산 열분해식	3	$4\text{HNO}_3 \rightarrow 2\text{H}_2\text{O} + 4\text{NO}_2 + \text{O}_2$ (질산) (물) (이산화질소) (산소)
64	질산암모늄 열분해식	2	$2\text{NH}_4\text{NO}_3 \rightarrow 2\text{N}_2 + \text{O}_2 + 4\text{H}_2\text{O}$ (질산암모늄) (질소) (산소) (물)
65	질산칼륨 열분해식	2	$2\text{KNO}_3 \rightarrow 2\text{KNO}_2 + \text{O}_2$ (질산칼륨) (아질산칼륨) (산소)
66	철 + 염산	5	$\text{Fe} + 2\text{HCl} \rightarrow \text{FeCl}_2 + \text{H}_2$ (철) (염산) (염화제일철) (수소)
67	초산에틸 제조	1	$\text{CH}_3\text{COOH} + \text{C}_2\text{H}_5\text{OH} \xrightarrow[\text{에스테르화}]{\text{C-H}_2\text{SO}_4} \text{CH}_3\text{COOC}_2\text{H}_5 + \text{H}_2\text{O}$ (초산) (에틸알코올) (초산에틸) (물)
68	칼륨 + 물	1	$2\text{K} + 2\text{H}_2\text{O} \rightarrow 2\text{KOH} + \text{H}_2$ (칼륨) (물) (수산화칼륨) (수소)
69	칼륨 + 이산화탄소	3	$4\text{K} + 3\text{CO}_2 \rightarrow 2\text{K}_2\text{CO}_3 + \text{C}$ (칼륨) (이산화탄소) (탄산칼륨) (탄소)
70	칼슘 + 물	1	$\text{Ca} + 2\text{H}_2\text{O} \rightarrow \text{Ca}(\text{OH})_2 + \text{H}_2$ (칼슘) (물) (수산화칼슘) (수소)
71	탄산마그네슘 산화식	1	$\text{MgCO}_3 \rightarrow \text{MgO} + \text{CO}_2$ (탄산마그네슘) (산화마그네슘) (이산화탄소)
72	탄산수소나트륨 + 황산	1	$2\text{NaHCO}_3 + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + 2\text{CO}_2 + 2\text{H}_2\text{O}$ (탄산수소나트륨) (황산) (황산나트륨) (이산화탄소) (물)
73	탄화알루미늄 + 물	2	$\text{Al}_4\text{C}_3 + 12\text{H}_2\text{O} \rightarrow 4\text{Al}(\text{OH})_3 + 3\text{CH}_4$ (탄화알루미늄) (물) (수산화알루미늄) (메탄)
74	탄화칼슘 + 물	8	$\text{CaC}_2 + 2\text{H}_2\text{O} \rightarrow \text{Ca}(\text{OH})_2 + \text{C}_2\text{H}_2$ (탄화칼슘) (물) (수산화칼슘) (아세틸렌)
75	트리니트로톨루엔 분해식	1	$2\text{C}_6\text{H}_2\text{CH}_3(\text{NO}_2)_3 \rightarrow 12\text{CO} + 5\text{H}_2 + 3\text{N}_2 + 2\text{C}$ (트리니트로톨루엔) (일산화탄소) (수소) (질소) (탄소)
76	트리니트로톨루엔 제조	6	$\text{C}_6\text{H}_5\text{CH}_3 + 3\text{HNO}_3 \xrightarrow[\text{니트로화}]{\text{C-H}_2\text{SO}_4} \text{C}_6\text{H}_2\text{CH}_3(\text{NO}_2)_3 + 3\text{H}_2\text{O}$ (톨루엔) (질산) (트리니트로톨루엔) (물)
77	트리에틸알루미늄 + 메틸알코올	2	$(\text{C}_2\text{H}_5)_3\text{Al} + 3\text{CH}_3\text{OH} \rightarrow \text{Al}(\text{CH}_3\text{O})_3 + 3\text{C}_2\text{H}_6$ (트리에틸알루미늄) (메틸알코올) (트리에톡시알루미늄) (에탄)
78	트리에틸알루미늄 + 물	6	$(\text{C}_2\text{H}_5)_3\text{Al} + 3\text{H}_2\text{O} \rightarrow \text{Al}(\text{OH})_3 + 3\text{C}_2\text{H}_6$ (트리에틸알루미늄) (물) (수산화알루미늄) (에탄)
79	트리에틸알루미늄 연소식	2	$2(\text{C}_2\text{H}_5)_3\text{Al} + 21\text{O}_2 \rightarrow 12\text{CO}_2 + \text{Al}_2\text{O}_3 + 15\text{H}_2\text{O}$ (트리에틸알루미늄) (산소) (이산화탄소) (산화알루미늄) (물)
80	황(유황) + 산소	2	$\text{S} + \text{O}_2 \rightarrow \text{SO}_2$ (유황) (산소) (아황산가스)
81	황린 연소식	4	$\text{P}_4 + 5\text{O}_2 \rightarrow 2\text{P}_2\text{O}_5$ (황린) (산소) (오산화린)

<필답, 작업형 반응식 미정계수법>

제1종 분말 분해식(NaHCO₃)

1) 270℃ 분해식 미정계수법



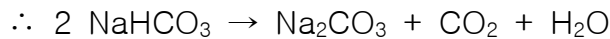
$$\textcircled{1} \text{ Na} : a = 2b \rightarrow b = a/2$$

$$\textcircled{2} \text{ H} : a = 2d \rightarrow d = a/2$$

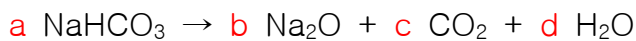
$$\textcircled{3} \text{ C} : a = b + c$$

$$\textcircled{4} \text{ O} : 3a = 3b + 2c + d \rightarrow 3a = (3a/2) + 2c + (a/2) \rightarrow a = 2c \rightarrow c = a/2$$

$a \text{ NaHCO}_3 \rightarrow (a/2) \text{ Na}_2\text{CO}_3 + (a/2) \text{ CO}_2 + (a/2) \text{ H}_2\text{O}$ 이므로 a 에 2를 대입해서 최소의 정수비로 맞추어 주면,



2) 850℃ 분해식 미정계수법



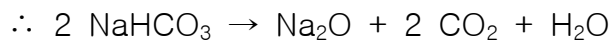
$$\textcircled{1} \text{ Na} : a = 2b \rightarrow b = a/2$$

$$\textcircled{2} \text{ H} : a = 2d \rightarrow d = a/2$$

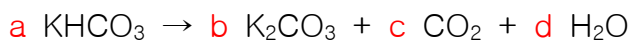
$$\textcircled{3} \text{ C} : a = c$$

$$\textcircled{4} \text{ O} : 3a = b + 2c + d$$

$a \text{ NaHCO}_3 \rightarrow (a/2) \text{ Na}_2\text{O} + a \text{ CO}_2 + (a/2) \text{ H}_2\text{O}$ 이므로 a 에 2를 대입해서 최소의 정수비로 맞추어 주면,



제2종 분말 분해식(KHCO₃)



$$\textcircled{1} \text{ K} : a = 2b \rightarrow b = a/2$$

$$\textcircled{2} \text{ H} : a = 2d \rightarrow d = a/2$$

$$\textcircled{3} \text{ C} : a = b + c$$

$$\textcircled{4} \text{ O} : 3a = 3b + 2c + d \rightarrow 3a = (3a/2) + 2c + (a/2) \rightarrow a = 2c \rightarrow c = a/2$$

$a \text{ KHCO}_3 \rightarrow (a/2) \text{ K}_2\text{CO}_3 + (a/2) \text{ CO}_2 + (a/2) \text{ H}_2\text{O}$ 이므로 a 에 2를 대입해서 최소의 정수비로 맞추어 주면,



제3종 분말 분해식(NH₄H₂PO₄)

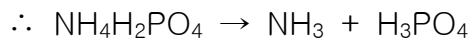
1) 1차 분해식



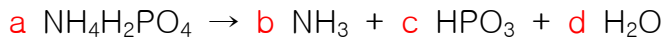
$$\textcircled{1} \text{ N} : a = b$$

$$\textcircled{2} \text{ H} : 6a = 3b + 3c$$

$$\textcircled{3} \text{ PO}_4 : a = c$$



2) 2차 분해식

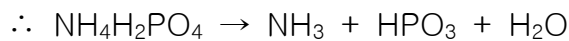
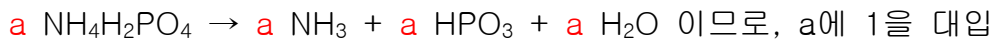


$$\textcircled{1} \text{ N} : a = b$$

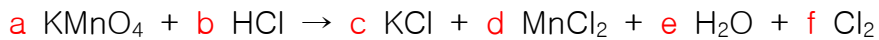
$$\textcircled{2} \text{ H} : 6a = 3b + c + 2d$$

$$\textcircled{3} \text{ P} : a = c$$

$$\textcircled{4} \text{ O} : 4a = 3c + d \rightarrow a = d$$



1. 과망간산칼륨 + 염산 미정계수법



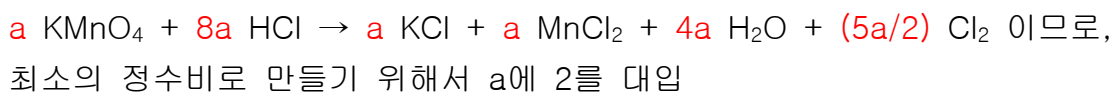
$$\textcircled{1} \text{ K} : a = c$$

$$\textcircled{2} \text{ Mn} : a = d$$

$$\textcircled{3} \text{ O} : 4a = e$$

$$\textcircled{4} \text{ H} : b = 2e \rightarrow b = 8a$$

$$\textcircled{5} \text{ Cl} : b = c + 2d + f \rightarrow 8a = a + 2a + 2f \rightarrow f = 5a/2$$



2. 과망간산칼륨 + 황산 미정계수법



$$\textcircled{1} \text{K} : a = 2c \rightarrow c = a/2$$

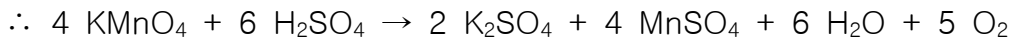
$$\textcircled{2} \text{Mn} : a = d$$

$$\textcircled{3} \text{H} : 2b = 2e \rightarrow b = e = 3a/2$$

$$\textcircled{4} \text{SO}_4 : b = c + d \rightarrow b = (a/2) + a \rightarrow b = 3a/2$$

$$\textcircled{5} \text{O} : 4a = e + 2f \rightarrow 4a = (3a/2) + 2f \rightarrow f = 5a/4$$

$a \text{KMnO}_4 + (3a/2) \text{H}_2\text{SO}_4 \rightarrow (a/2) \text{K}_2\text{SO}_4 + a \text{MnSO}_4 + (3a/2) \text{H}_2\text{O} + (5a/4) \text{O}_2$ 이므로, 최소의 정수비로 만들기 위해서 a 에 4를 대입



3. 과망간산칼륨 열 분해식



$$\textcircled{1} \text{K} : a = 2b \rightarrow b = a/2$$

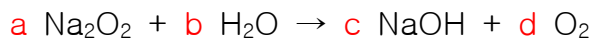
$$\textcircled{2} \text{Mn} : a = b + c \rightarrow a = (a/2) + c \rightarrow c = a/2$$

$$\textcircled{3} \text{O} : 4a = 4b + 2c + 2d \rightarrow 4a = 2a + a + 2d \rightarrow d = a/2$$

$a \text{KMnO}_4 \rightarrow (a/2) \text{K}_2\text{MnO}_4 + (a/2) \text{MnO}_2 + (a/2) \text{O}_2$ 이므로, 최소의 정수비로 만들기 위해서 a 에 2를 대입



4. 과산화나트륨 + 물 미정계수법

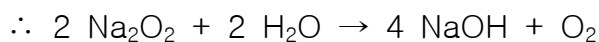


$$\textcircled{1} \text{Na} : 2a = c$$

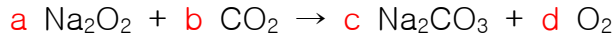
$$\textcircled{2} \text{O} : 2a + b = c + 2d \rightarrow 2a + a = 2a + 2d \rightarrow d = a/2$$

$$\textcircled{3} \text{H} : 2b = c \rightarrow 2a = 2b \text{ 이므로 } a = b$$

$a \text{Na}_2\text{O}_2 + a \text{H}_2\text{O} \rightarrow 2a \text{NaOH} + (a/2) \text{O}_2$ 이므로, 최소의 정수비로 만들기 위해서 a 에 2를 대입



5. 과산화나트륨 + 이산화탄소 미정계수법

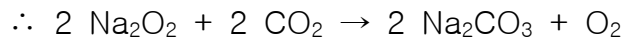


$$\textcircled{1} \text{ Na} : 2a = 2c \rightarrow a = c$$

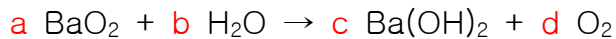
$$\textcircled{2} \text{ O} : 2a + 2b = 3c + 2d \rightarrow 2a + 2a = 3a + 2d \rightarrow d = (a/2)$$

$$\textcircled{3} \text{ C} : b = c \rightarrow b = a$$

$a \text{ Na}_2\text{O}_2 + a \text{ CO}_2 \rightarrow a \text{ Na}_2\text{CO}_3 + (a/2) \text{ O}_2$ 이므로, 최소의 정수비로 만들기 위해
서 a 에 2를 대입



6. 과산화바륨 + 물 미정계수법

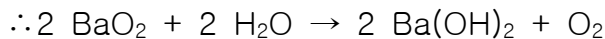


$$\textcircled{1} \text{ Ba} : a = c$$

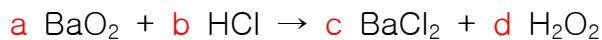
$$\textcircled{2} \text{ O} : 2a + b = 2c + 2d \rightarrow 2a + a = 2a + 2d \rightarrow d = a/2$$

$$\textcircled{3} \text{ H} : 2b = 2c \rightarrow b = c = a$$

$a \text{ BaO}_2 + a \text{ H}_2\text{O} \rightarrow a \text{ Ba(OH)}_2 + (a/2) \text{ O}_2$ 이므로, 최소의 정수비로 만들기 위해
서 a 에 2를 대입



7. 과산화바륨 + 염산 미정계수법



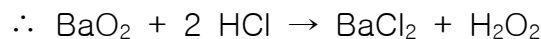
$$\textcircled{1} \text{ Ba} : a = c$$

$$\textcircled{2} \text{ O} : 2a = 2d \rightarrow a = d$$

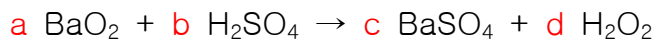
$$\textcircled{3} \text{ H} : b = 2d \rightarrow b = 2a$$

$$\textcircled{4} \text{ Cl} : b = 2c$$

$a \text{ BaO}_2 + 2a \text{ HCl} \rightarrow a \text{ BaCl}_2 + a \text{ H}_2\text{O}_2$ 이므로, 최소의 정수비로 만들기 위해서
 a 에 1을 대입



8. 과산화바륨 + 황산 미정계수법



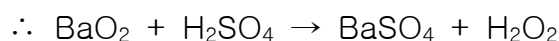
$$\textcircled{1} \text{ Ba} : a = c$$

$$\textcircled{2} \text{ O} : 2a = 2d \rightarrow a = d$$

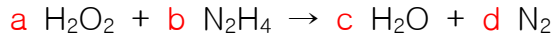
$$\textcircled{3} \text{ H} : 2b = 2d \rightarrow b = a$$

$$\textcircled{4} \text{ SO}_4 : b = c$$

$a \text{ BaO}_2 + a \text{ H}_2\text{SO}_4 \rightarrow a \text{ BaSO}_4 + a \text{ H}_2\text{O}_2$ 이므로, 최소의 정수비로 만들기 위해
서 a 에 1을 대입

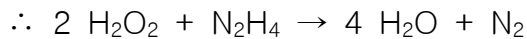


9. 과산화수소 + 히드라진 미정계수법



- ① H : $2a + 4b = 2c \rightarrow 2a + 4b = 4a \rightarrow b = a/2$
- ② O : $2a = c$
- ③ N : $2b = 2d \rightarrow d = a/2$

$a \text{ H}_2\text{O}_2 + (a/2) \text{ N}_2\text{H}_4 \rightarrow 2a \text{ H}_2\text{O} + (a/2) \text{ N}_2$ 이므로, 최소의 정수비로 만들기 위해서 a에 2를 대입

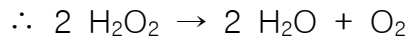


10. 과산화수소 분해식 미정계수법

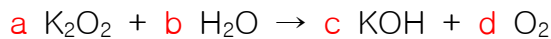


- ① H : $2a = 2b \rightarrow a = b$
- ② O : $2a = b + 2c \rightarrow c = a/2$

$a \text{ H}_2\text{O}_2 \rightarrow a \text{ H}_2\text{O} + (a/2) \text{ O}_2$ 이므로, 최소의 정수비로 만들기 위해서 a에 2를 대입

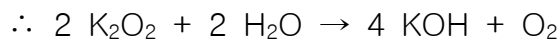


11. 과산화칼륨 + 물 미정계수법



- ① K : $2a = c$
- ② O : $2a + b = c + 2d \rightarrow 2a + a = 2a + 2d \rightarrow d = a/2$
- ③ H : $2b = c \rightarrow 2a = 2b$ 이므로 $a = b$

$a \text{ K}_2\text{O}_2 + a \text{ H}_2\text{O} \rightarrow 2a \text{ KOH} + (a/2) \text{ O}_2$ 이므로, 최소의 정수비로 만들기 위해서 a에 2를 대입

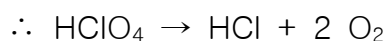


12. 과염소산 분해식 미정계수법

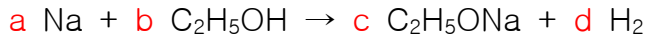


- ① HCl : $a = b$
- ② O : $4a = 2c \rightarrow 2a = c$

$a \text{ HClO}_4 \rightarrow a \text{ HCl} + 2a \text{ O}_2$ 이므로, 최소의 정수비로 만들기 위해서 a에 1을 대입



17. 나트륨 + 에탄올 미정계수법

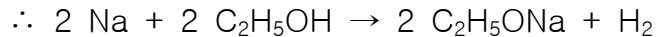


$$\textcircled{1} \text{ Na} : a = c$$

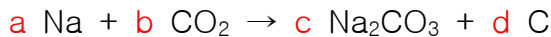
$$\textcircled{2} \text{ C}_2\text{H}_5\text{O} : b = c$$

$$\textcircled{3} \text{ H} : b = 2d \rightarrow d = a/2$$

$a \text{ Na} + a \text{ C}_2\text{H}_5\text{OH} \rightarrow a \text{ C}_2\text{H}_5\text{ONa} + (a/2) \text{ H}_2$ 이므로, 최소의 정수비로 만들기 위해서 a 에 2를 대입



18. 나트륨 + 이산화탄소 미정계수법

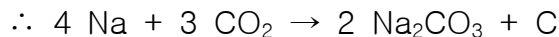


$$\textcircled{1} \text{ Na} : a = 2c \rightarrow c = a/2$$

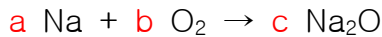
$$\textcircled{2} \text{ C} : b = c + d \rightarrow d = a/4$$

$$\textcircled{3} \text{ O} : 2b = 3c \rightarrow b = 3a/4$$

$a \text{ Na} + (3a/4) \text{ CO}_2 \rightarrow (a/2) \text{ Na}_2\text{CO}_3 + (a/4) \text{ C}$ 이므로, 최소의 정수비로 만들기 위해서 a 에 4를 대입



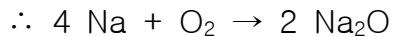
19. 나트륨 연소식 미정계수법



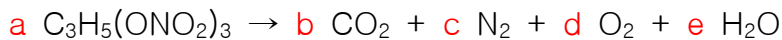
$$\textcircled{1} \text{ Na} : a = 2c \rightarrow c = a/2$$

$$\textcircled{2} \text{ O} : 2b = c \rightarrow b = a/4$$

$a \text{ Na} + (a/4) \text{ O}_2 \rightarrow (a/2) \text{ Na}_2\text{O}$ 이므로, 최소의 정수비로 만들기 위해서 a 에 4를 대입



20. 니트로글리세린 열분해식 미정계수법



$$\textcircled{1} \text{ C} : 3a = b$$

$$\textcircled{2} \text{ H} : 5a = 2e \rightarrow e = 5a/2$$

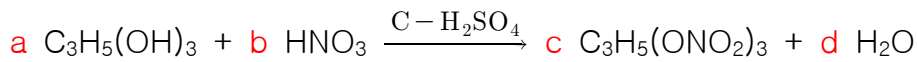
$$\textcircled{3} \text{ O} : 9a = 2b + 2d + e \rightarrow 9a = 6a + (5a/2) + 2d \rightarrow d = a/4$$

$$\textcircled{4} \text{ N} : 3a = 2c \rightarrow c = 3a/2$$

$a \text{ C}_3\text{H}_5(\text{ONO}_2)_3 \rightarrow 3a \text{ CO}_2 + (3a/2) \text{ N}_2 + (a/4) \text{ O}_2 + (5a/2) \text{ H}_2\text{O}$ 이므로, 최소의 정수비로 만들기 위해서 a 에 4를 대입

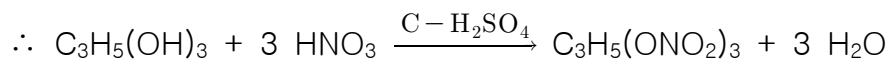


21. 니트로글리세린 제조법 미정계수법

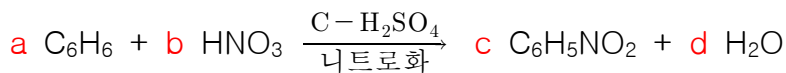


- ① $\text{C}_3\text{H}_5 : a = c$
- ② $\text{O} : 3a + 3b = 9c + d$
- ③ $\text{H} : 3a + b = 2d \rightarrow 6a = 2d \rightarrow d = 3a$
- ④ $\text{N} : b = 3c \rightarrow b = 3a$

$a \text{ C}_3\text{H}_5(\text{OH})_3 + 3a \text{ HNO}_3 \rightarrow a \text{ C}_3\text{H}_5(\text{ONO}_2)_3 + 3a \text{ H}_2\text{O}$ 이므로, 최소의 정수비로 만들기 위해서 a에 1을 대입

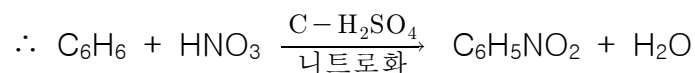


22. 니트로벤젠 제조법 미정계수법

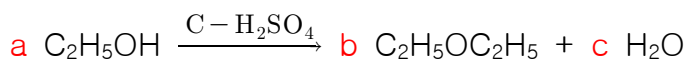


- ① $\text{C}_6\text{H}_5 : a = c$
- ② $\text{H} : a + b = 2d \rightarrow a = d$
- ③ $\text{NO}_2 : b = c \rightarrow a = b$
- ④ $\text{O} : b = d$

$a = b = c = d$ 이므로 계수는 1이 된다. (최소의 정수비를 맞추어 주기 때문에)

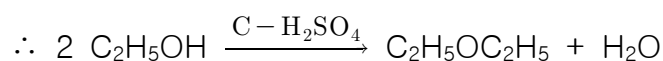


23. 디에틸에테르 제조 미정계수법

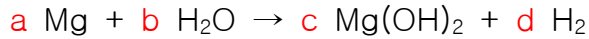


- ① $\text{C}_2\text{H}_5 : a = 2b \rightarrow b = a/2$
- ② $\text{O} : a = b + c$
- ③ $\text{H} : a = 2c \rightarrow c = a/2$

$a \text{ C}_2\text{H}_5\text{OH} \xrightarrow{\text{C}-\text{H}_2\text{SO}_4} (a/2) \text{ C}_2\text{H}_5\text{OC}_2\text{H}_5 + (a/2) \text{ H}_2\text{O}$ 이므로, 최소의 정수비로 만들기 위해서 a에 2를 대입



24. 마그네슘 + 물 미정계수법

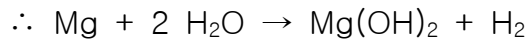


$$\textcircled{1} \text{ Mg} : a = c$$

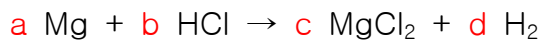
$$\textcircled{2} \text{ OH} : b = 2c \rightarrow b = 2a$$

$$\textcircled{3} \text{ H} : b = 2d \rightarrow d = a$$

$a \text{ Mg} + 2a \text{ H}_2\text{O} \rightarrow a \text{ Mg(OH)}_2 + a \text{ H}_2$ 이므로, 최소의 정수비로 만들기 위해서 a 에 1을 대입



25. 마그네슘 + 염산 미정계수법

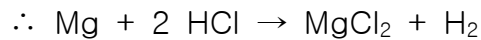


$$\textcircled{1} \text{ Mg} : a = c$$

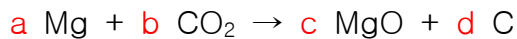
$$\textcircled{2} \text{ Cl} : b = 2c \rightarrow b = 2a$$

$$\textcircled{3} \text{ H} : b = 2d \rightarrow d = a$$

$a \text{ Mg} + 2a \text{ HCl} \rightarrow a \text{ MgCl}_2 + a \text{ H}_2$ 이므로, 최소의 정수비로 만들기 위해서 a 에 1을 대입



26. 마그네슘 + 이산화탄소 미정계수법

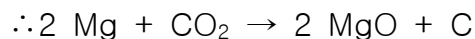


$$\textcircled{1} \text{ Mg} : a = c$$

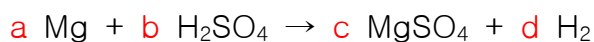
$$\textcircled{2} \text{ C} : b = d \rightarrow d = a/2$$

$$\textcircled{3} \text{ O} : 2b = c \rightarrow b = a/2$$

$a \text{ Mg} + (a/2) \text{ CO}_2 \rightarrow a \text{ MgO} + (a/2) \text{ C}$ 이므로, 최소의 정수비로 만들기 위해서 a 에 2를 대입



27. 마그네슘 + 황산 미정계수법

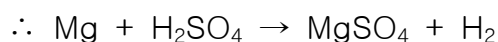


$$\textcircled{1} \text{ Mg} : a = c$$

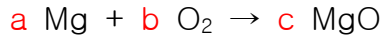
$$\textcircled{2} \text{ SO}_4 : b = c$$

$$\textcircled{3} \text{ H} : 2b = 2d \rightarrow b = d = c = a$$

$a = b = c = d$ 이므로 계수는 1이 된다. (최소의 정수비를 맞추어 주기 때문에)



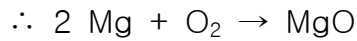
28. 마그네슘 연소식 미정계수법



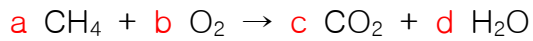
$$\textcircled{1} \text{ Mg} : a = c$$

$$\textcircled{2} \text{ O} : 2b = c \rightarrow b = a/2$$

$a \text{ Mg} + (a/2) \text{ O}_2 \rightarrow a \text{ MgO}$ 이므로, 최소의 정수비로 만들기 위해서 a 에 2를 대입



29. 메탄 분해식 미정계수법

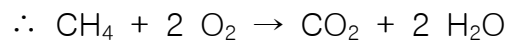


$$\textcircled{1} \text{ C} : a = c$$

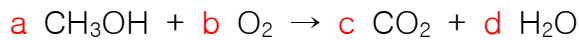
$$\textcircled{2} \text{ H} : 4a = 2d \rightarrow d = 2a$$

$$\textcircled{3} \text{ O} : 2b = 2c + d \rightarrow 2b = 2a + 2a \rightarrow b = 2a$$

$a \text{ CH}_4 + 2a \text{ O}_2 \rightarrow a \text{ CO}_2 + 2a \text{ H}_2\text{O}$ 이므로, 최소의 정수비로 만들기 위해서 a 에 1을 대입



30. 메탄올 연소식 미정계수법

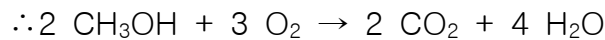


$$\textcircled{1} \text{ C} : a = c$$

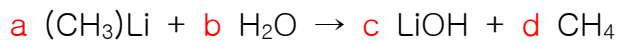
$$\textcircled{2} \text{ H} : 4a = 2d \rightarrow d = 2a$$

$$\textcircled{3} \text{ O} : a + 2b = 2c + d \rightarrow a + 2b = 2a + 2a \rightarrow b = 3a/2$$

$a \text{ CH}_3\text{OH} + (3a/2) \text{ O}_2 \rightarrow a \text{ CO}_2 + 2a \text{ H}_2\text{O}$ 이므로, 최소의 정수비로 만들기 위해서 a 에 2를 대입



31. 메틸리튬 + 물 미정계수법



$$\textcircled{1} \text{ CH}_3 : a = d$$

$$\textcircled{2} \text{ Li} : a = c$$

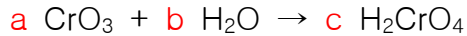
$$\textcircled{3} \text{ OH} : b = c$$

$$\textcircled{4} \text{ H} : b = d$$

$a = b = c = d$ 이므로 계수는 1이 된다. (최소의 정수비를 맞추어 주기 때문에)



32. 삼산화크롬 + 물 미정계수법

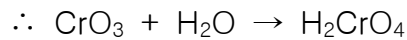


$$\textcircled{1} \text{ Cr} : a = c$$

$$\textcircled{2} \text{ O} : 3a + b = 4c$$

$$\textcircled{3} \text{ H} : 2b = 2c \rightarrow b = c$$

$a = b = c$ 이므로 계수는 1이 된다. (최소의 정수비를 맞추어 주기 때문에)



33. 삼산화크롬 열분해식 미정계수법



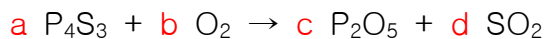
$$\textcircled{1} \text{ Cr} : a = 2b \rightarrow b = a/2$$

$$\textcircled{2} \text{ O} : 3a = 3b + 2c \rightarrow c = 3a/4$$

$a \text{ CrO}_3 \rightarrow (a/2) \text{ Cr}_2\text{O}_3 + (3a/4) \text{ O}_2$ 이므로, 최소의 정수비로 만들기 위해서 a 에 4를 대입



34. 삼황화린 연소식 미정계수법

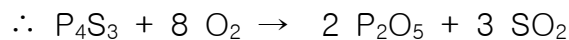


$$\textcircled{1} \text{ P} : 4a = 2c \rightarrow c = 2a$$

$$\textcircled{2} \text{ S} : 3a = d$$

$$\textcircled{3} \text{ O} : 2b = 5c + 2d \rightarrow b = 8a$$

$a \text{ P}_4\text{S}_3 + 8a \text{ O}_2 \rightarrow 2a \text{ P}_2\text{O}_5 + 3a \text{ SO}_2$ 이므로, 최소의 정수비로 만들기 위해서 a 에 1을 대입



35. 수소화알루미늄리튬 + 물 미정계수법



$$\textcircled{1} \text{ Li} : a = c$$

$$\textcircled{2} \text{ Al} : a = d$$

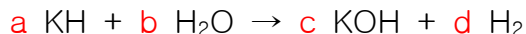
$$\textcircled{3} \text{ OH} : b = c + 3d \rightarrow b = 4a$$

$$\textcircled{4} \text{ H} : 4a + b = 2e \rightarrow 8a = 2e \rightarrow e = 4a$$

$a \text{ LiAlH}_4 + 4a \text{ H}_2\text{O} \rightarrow a \text{ LiOH} + a \text{ Al(OH)}_3 + 4a \text{ H}_2$ 이므로, 최소의 정수비로 만들기 위해서 a 에 1을 대입



36. 수소화칼륨 + 물 미정계수법

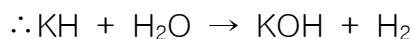


$$\textcircled{1} \text{ K} : a = c$$

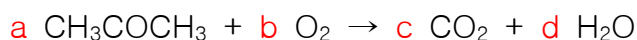
$$\textcircled{2} \text{ OH} : b = c$$

$$\textcircled{3} \text{ H} : a + b = 2d \rightarrow d = a$$

$a = b = c = d$ 이므로 계수는 1이 된다. (최소의 정수비를 맞추어 주기 때문에)



37. 아세톤 연소식 미정계수법

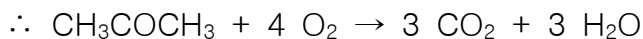


$$\textcircled{1} \text{ C} : 3a = c$$

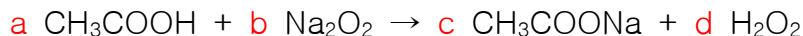
$$\textcircled{2} \text{ H} : 6a = 2d \rightarrow d = 3a$$

$$\textcircled{3} \text{ O} : a + 2b = 2c + d \rightarrow b = 4a$$

$a \text{ CH}_3\text{COCH}_3 + 4a \text{ O}_2 \rightarrow 3a \text{ CO}_2 + 3a \text{ H}_2\text{O}$ 이므로, 최소의 정수비로 만들기 위해서 a 에 1을 대입



38. 아세트산 + 과산화나트륨 미정계수법



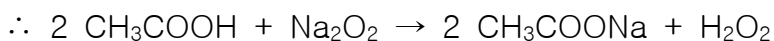
$$\textcircled{1} \text{ CH}_3\text{COO} : a = c$$

$$\textcircled{2} \text{ H} : a = 2d \rightarrow d = a/2$$

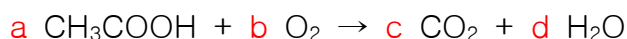
$$\textcircled{3} \text{ Na} : 2b = c \rightarrow b = a/2$$

$$\textcircled{4} \text{ O} : 2b = 2d \rightarrow b = d$$

$a \text{ CH}_3\text{COOH} + (a/2) \text{ Na}_2\text{O}_2 \rightarrow a \text{ CH}_3\text{COONa} + (a/2) \text{ H}_2\text{O}_2$ 이므로, 최소의 정수비로 만들기 위해서 a 에 2를 대입



39. 아세트산 연소식 미정계수법

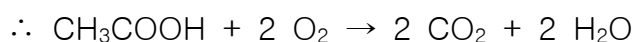


$$\textcircled{1} \text{ C} : 2a = c$$

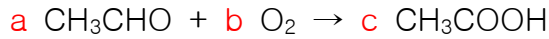
$$\textcircled{2} \text{ H} : 4a = 2d \rightarrow d = 2a$$

$$\textcircled{3} \text{ O} : 2a + 2b = 2c + d \rightarrow b = 2a$$

$a \text{ CH}_3\text{COOH} + 2a \text{ O}_2 \rightarrow 2a \text{ CO}_2 + 2a \text{ H}_2\text{O}$ 이므로, 최소의 정수비로 만들기 위해서 a 에 1을 대입



40. 아세트알데히드 산화식 미정계수법



$$\textcircled{1} \text{ C} : 2a = 2c \rightarrow a = c$$

$$\textcircled{2} \text{ O} : a + 2b = 2c \rightarrow b = a/2$$

$a \text{ CH}_3\text{CHO} + (a/2) \text{ O}_2 \rightarrow a \text{ CH}_3\text{COOH}$ 이므로, 최소의 정수비로 만들기 위해서 a 에 2를 대입



41. 아세틸렌 + 구리 미정계수법

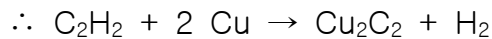


$$\textcircled{1} \text{ C} : 2a = 2c \rightarrow a = c$$

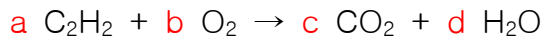
$$\textcircled{2} \text{ H} : 2a = 2d \rightarrow a = d$$

$$\textcircled{3} \text{ Cu} : b = 2c \rightarrow b = 2a$$

$a \text{ C}_2\text{H}_2 + 2a \text{ Cu} \rightarrow a \text{ Cu}_2\text{C}_2 + a \text{ H}_2$ 이므로, 최소의 정수비로 만들기 위해서 a 에 1을 대입



42. 아세틸렌 연소식 미정계수법

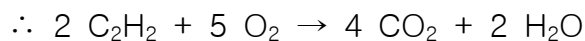


$$\textcircled{1} \text{ C} : 2a = c$$

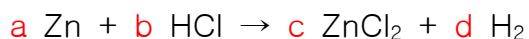
$$\textcircled{2} \text{ H} : 2a = 2d \rightarrow a = d$$

$$\textcircled{3} \text{ O} : 2b = 2c + d \rightarrow b = 5a/2$$

$a \text{ C}_2\text{H}_2 + (5a/2) \text{ O}_2 \rightarrow 2a \text{ CO}_2 + a \text{ H}_2\text{O}$ 이므로, 최소의 정수비로 만들기 위해서 a 에 2를 대입



43. 아연 + 염산 미정계수법

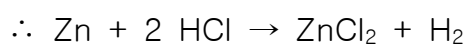


$$\textcircled{1} \text{ Zn} : a = c$$

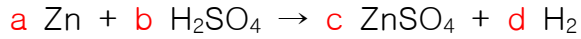
$$\textcircled{2} \text{ H} : b = 2d \rightarrow d = a$$

$$\textcircled{3} \text{ Cl} : b = 2c \rightarrow b = 2a$$

$a \text{ Zn} + 2a \text{ HCl} \rightarrow a \text{ ZnCl}_2 + a \text{ H}_2$ 이므로, 최소의 정수비로 만들기 위해서 a 에 1을 대입



44. 아연 + 황산 미정계수법

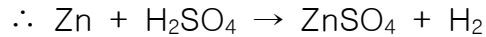


$$\textcircled{1} \text{ Zn} : a = c$$

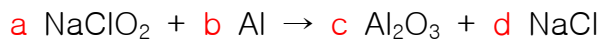
$$\textcircled{2} \text{ H} : 2b = 2d \rightarrow d = b$$

$$\textcircled{3} \text{ SO}_4 : b = c$$

$a = b = c = d$ 이므로 계수는 1이 된다. (최소의 정수비를 맞추어 주기 때문에)



45. 아염소산나트륨 + 알루미늄 미정계수법

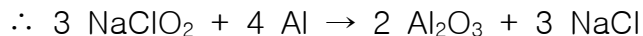


$$\textcircled{1} \text{ NaCl} : a = d$$

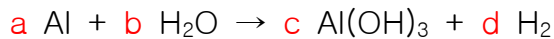
$$\textcircled{2} \text{ O} : 2a = 3c \rightarrow c = \frac{2a}{3}$$

$$\textcircled{3} \text{ Al} : b = 2c \rightarrow b = \frac{4a}{3}$$

$a \text{ NaClO}_2 + \frac{4a}{3} \text{ Al} \rightarrow \frac{2a}{3} \text{ Al}_2\text{O}_3 + a \text{ NaCl}$ 이므로, 최소의 정수비로 만들기 위해서 a 에 3을 대입



46. 알루미늄 + 물 미정계수법

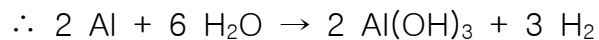


$$\textcircled{1} \text{ Al} : a = c$$

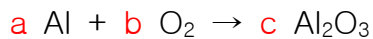
$$\textcircled{2} \text{ OH} : b = 3c \rightarrow b = 3a$$

$$\textcircled{3} \text{ H} : b = 2d \rightarrow d = \frac{3a}{2}$$

$a \text{ Al} + 3a \text{ H}_2\text{O} \rightarrow a \text{ Al(OH)}_3 + \frac{3a}{2} \text{ H}_2$ 이므로, 최소의 정수비로 만들기 위해서 a 에 2를 대입



47. 알루미늄 연소식 미정계수법



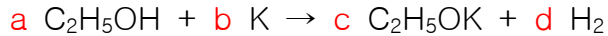
$$\textcircled{1} \text{ Al} : a = 2c \rightarrow c = \frac{a}{2}$$

$$\textcircled{2} \text{ O} : 2b = 3c \rightarrow 2b = \frac{3a}{2} \rightarrow b = \frac{3a}{4}$$

$a \text{ Al} + \frac{3a}{4} \text{ O}_2 \rightarrow \frac{a}{2} \text{ Al}_2\text{O}_3$ 이므로, 최소의 정수비로 만들기 위해서 a 에 4를 대입



48. 에탄올 + 칼륨 미정계수법



$$\textcircled{1} \text{ C}_2\text{H}_5\text{O} : a = c$$

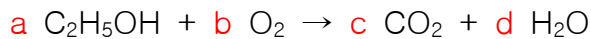
$$\textcircled{2} \text{ H} : a = 2d \rightarrow d = a/2$$

$$\textcircled{3} \text{ K} : b = c$$

$a \text{ C}_2\text{H}_5\text{OH} + a \text{ K} \rightarrow a \text{ C}_2\text{H}_5\text{OK} + (a/2) \text{ H}_2$ 이므로, 최소의 정수비로 만들기 위해서 a 에 2를 대입



49. 에탄올 연소식 미정계수법

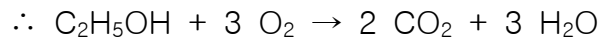


$$\textcircled{1} \text{ C} : 2a = c$$

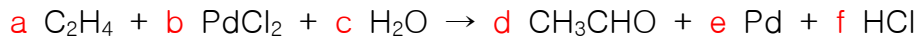
$$\textcircled{2} \text{ H} : 6a = 2d \rightarrow d = 3a$$

$$\textcircled{3} \text{ O} : a + 2b = 2c + d \rightarrow a + 2b = 4a + 3a \rightarrow b = 3a$$

$a \text{ C}_2\text{H}_5\text{OH} + 3a \text{ O}_2 \rightarrow 2a \text{ CO}_2 + 3a \text{ H}_2\text{O}$ 이므로, 최소의 정수비로 만들기 위해서 a 에 1을 대입



50. 에틸렌 산화식 미정계수법



$$\textcircled{1} \text{ C} : 2a = 2d \rightarrow a = d$$

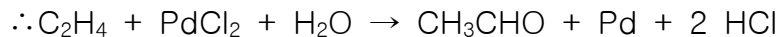
$$\textcircled{2} \text{ H} : 4a + 2c = 4d + f \rightarrow f = 2c \rightarrow f = 2a$$

$$\textcircled{3} \text{ Pd} : b = e$$

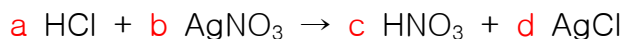
$$\textcircled{4} \text{ Cl} : 2b = f \rightarrow 2b = 2c \rightarrow b = c$$

$$\textcircled{5} \text{ O} : c = d$$

$a \text{ C}_2\text{H}_4 + a \text{ PdCl}_2 + a \text{ H}_2\text{O} \rightarrow a \text{ CH}_3\text{CHO} + a \text{ Pd} + 2a \text{ HCl}$ 이므로, 최소의 정수비로 만들기 위해서 a 에 1을 대입($a = b = c = d = e$, $f = 2a$)



51. 염산 + 질산은 미정계수법

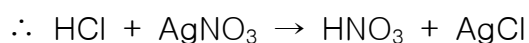


$$\textcircled{1} \text{ H} : a = c$$

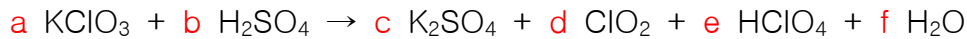
$$\textcircled{2} \text{ Cl} : a = d$$

$$\textcircled{3} \text{ Ag} : b = d$$

$a = b = c = d$ 이므로 계수는 1이 된다. (최소의 정수비를 맞추어 주기 때문에)



52. 염소산칼륨 + 황산 미정계수법



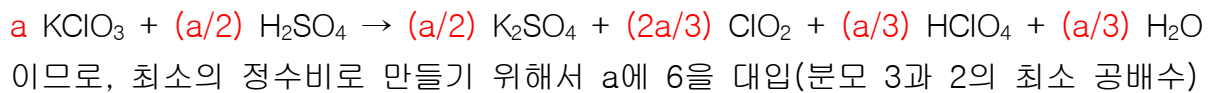
$$\textcircled{1} \text{K} : a = 2c \rightarrow c = a/2$$

$$\textcircled{2} \text{Cl} : a = d + e \rightarrow 2a = 2d + 2e \quad \textcircled{3} - \textcircled{2} \rightarrow a = 2e + f = e + 2f \rightarrow e = f$$

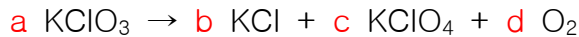
$$\textcircled{3} \text{O} : 3a = 2d + 4e + f \rightarrow 3a = 2d + (5a/3) \rightarrow 4a/3 = 2d \rightarrow d = 2a/3$$

$$\textcircled{4} \text{H} : 2b = e + 2f \rightarrow a = e + 2f \rightarrow a = 3e \rightarrow e = a/3$$

$$\textcircled{5} \text{SO}_4 : b = c \rightarrow b = a/2$$



53. 염소산칼륨 400°C 열분해식 미정계수법



$$\textcircled{1} \text{K} : a = b + c$$

$$\textcircled{2} \text{Cl} : a = b + c$$

$$\textcircled{3} \text{O} : 3a = 4c + 2d$$

이 반응식은 미정계수법으로 풀 수 없다.

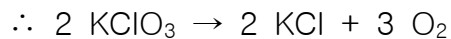
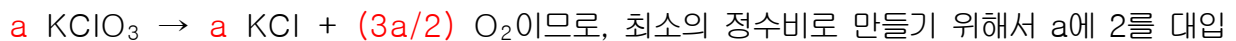


54. 염소산칼륨 540~560°C 열분해식 미정계수법

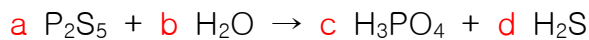


$$\textcircled{1} \text{KCl} : a = b$$

$$\textcircled{2} \text{O} : 3a = 2c \rightarrow c = 3a/2$$



55. 오황화린 + 물 미정계수법

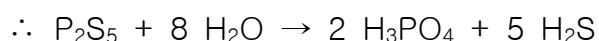
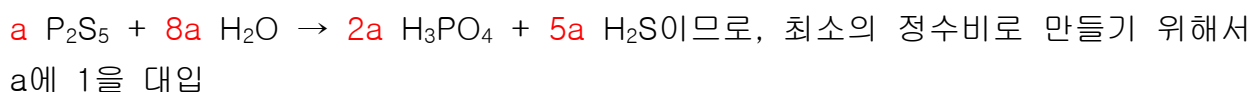


$$\textcircled{1} \text{P} : 2a = c$$

$$\textcircled{2} \text{S} : 5a = d$$

$$\textcircled{3} \text{H} : 2b = 3c + d$$

$$\textcircled{4} \text{O} : b = 4c \rightarrow b = 8a$$



56. 이산화망간 + 과산화수소 미정계수법

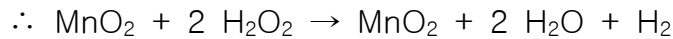


① MnO₂ : $a = c$ (반응 전 후에 변화가 없는 촉매)

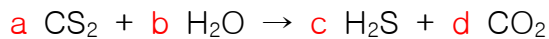
② H₂O : $b = d$

③ H : $b = 2e \rightarrow e = b/2$

$a \text{ MnO}_2 + b \text{ H}_2\text{O}_2 \rightarrow a \text{ MnO}_2 + b \text{ H}_2\text{O} + (b/2) \text{ H}_2$ 이므로, 최소의 정수비로 만들기 위해서 a에 1을 대입, b에 2를 대입



57. 이황화탄소 + 물 미정계수법



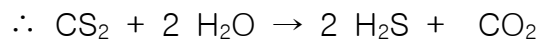
① C : $a = d$

② S : $2a = c$

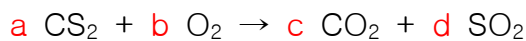
③ H : $2b = 2c \rightarrow b = c$

④ O : $b = 2d \rightarrow d = a$

$a \text{ CS}_2 + 2a \text{ H}_2\text{O} \rightarrow 2a \text{ H}_2\text{S} + a \text{ CO}_2$ 이므로, 최소의 정수비로 만들기 위해서 a에 1을 대입



58. 이황화탄소 연소식

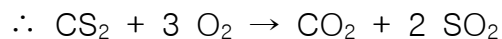


① C : $a = c$

② S : $2a = d$

③ O : $2b = 2c + 2d \rightarrow b = 3a$

$a \text{ CS}_2 + 3a \text{ O}_2 \rightarrow a \text{ CO}_2 + 2a \text{ SO}_2$ 이므로, 최소의 정수비로 만들기 위해서 a에 1을 대입



59. 인화알루미늄 + 물 미정계수법



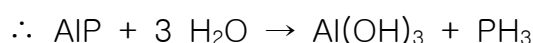
① Al : $a = c$

② P : $a = d$

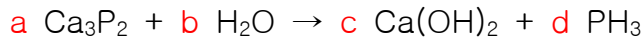
③ OH : $b = 3c \rightarrow b = 3a$

④ H : $b = 3d$

$a \text{ AlP} + 3a \text{ H}_2\text{O} \rightarrow a \text{ Al(OH)}_3 + a \text{ PH}_3$ 이므로, 최소의 정수비로 만들기 위해서 a에 1을 대입



60. 인화칼슘 + 물 미정계수법



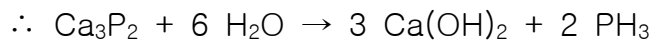
$$\textcircled{1} \text{ Ca} : 3a = c$$

$$\textcircled{2} \text{ P} : 2a = d$$

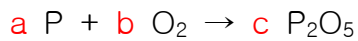
$$\textcircled{3} \text{ OH} : b = 2c \rightarrow b = 6a$$

$$\textcircled{4} \text{ H} : b = 3d$$

$a \text{ Ca}_3\text{P}_2 + 6a \text{ H}_2\text{O} \rightarrow 3a \text{ Ca(OH)}_2 + 2a \text{ PH}_3$ 이므로, 최소의 정수비로 만들기 위해서 a 에 1을 대입



61. 적린 연소식 미정계수법



$$\textcircled{1} \text{ P} : a = 2c \rightarrow c = a/2$$

$$\textcircled{2} \text{ O} : 2b = 5c \rightarrow b = 5a/4$$

$a \text{ P} + (5a/4) \text{ O}_2 \rightarrow (a/2) \text{ P}_2\text{O}_5$ 이므로, 최소의 정수비로 만들기 위해서 a 에 4를 대입



62. 중크롬산칼륨 열 분해식 미정계수법

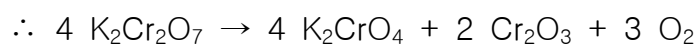


$$\textcircled{1} \text{ K} : 2a = 2b \rightarrow a = b$$

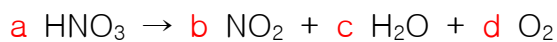
$$\textcircled{2} \text{ Cr} : 2a = b + 2c \rightarrow c = a/2$$

$$\textcircled{3} \text{ O} : 7a = 4b + 3c + 2d \rightarrow d = 3a/4$$

$a \text{ K}_2\text{Cr}_2\text{O}_7 \rightarrow a \text{ K}_2\text{CrO}_4 + (a/2) \text{ Cr}_2\text{O}_3 + (3a/4) \text{ O}_2$ 이므로, 최소의 정수비로 만들기 위해서 a 에 4를 대입



63. 질산 열분해식 미정계수법



$$\textcircled{1} \text{ H} : a = 2c \rightarrow c = a/2$$

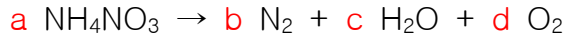
$$\textcircled{2} \text{ NO}_2 : a = b$$

$$\textcircled{3} \text{ O} : a = c + 2d \rightarrow d = a/4$$

$a \text{ HNO}_3 \rightarrow a \text{ NO}_2 + (a/2) \text{ H}_2\text{O} + (a/4) \text{ O}_2$ 이므로, 최소의 정수비로 만들기 위해서 a 에 4를 대입



64. 질산암모늄 열분해식 미정계수법

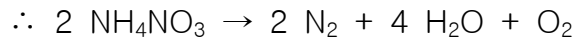


$$\textcircled{1} \text{ N} : 2a = 2b \rightarrow a = b$$

$$\textcircled{2} \text{ H} : 4a = 2c \rightarrow c = 2a$$

$$\textcircled{3} \text{ O} : 3a = c + 2d \rightarrow d = a/2$$

$a \text{ NH}_4\text{NO}_3 \rightarrow a \text{ N}_2 + 2a \text{ H}_2\text{O} + (a/2) \text{ O}_2$ 이므로, 최소의 정수비로 만들기 위해서 a 에 2를 대입



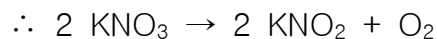
65. 질산칼륨 분해식 미정계수법



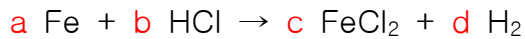
$$\textcircled{1} \text{ KNO}_2 : a = b$$

$$\textcircled{2} \text{ O} : a = 2c \rightarrow c = a/2$$

$a \text{ KNO}_3 \rightarrow a \text{ KNO}_2 + (a/2) \text{ O}_2$ 이므로, 최소의 정수비로 만들기 위해서 a 에 2를 대입



66. 철 + 염산 미정계수법

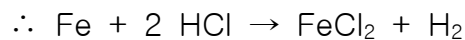


$$\textcircled{1} \text{ Fe} : a = c$$

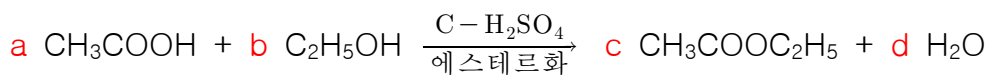
$$\textcircled{2} \text{ H} : b = 2d \rightarrow d = a$$

$$\textcircled{3} \text{ Cl} : b = 2c \rightarrow b = 2a$$

$a \text{ Fe} + 2a \text{ HCl} \rightarrow a \text{ FeCl}_2 + a \text{ H}_2$ 이므로, 최소의 정수비로 만들기 위해서 a 에 1을 대입



67. 초산에틸 제조 미정계수법



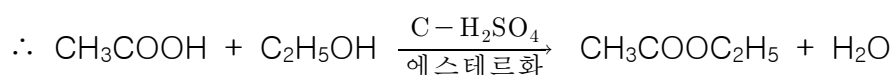
$$\textcircled{1} \text{ CH}_3\text{COO} : a = c$$

$$\textcircled{2} \text{ C}_2\text{H}_5 : b = c$$

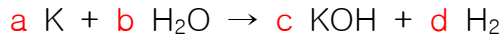
$$\textcircled{3} \text{ H} : a = d$$

$$\textcircled{4} \text{ OH} : b = d$$

$a = b = c = d$ 이므로 계수는 1이 된다. (최소의 정수비를 맞추어 주기 때문에)



68. 칼륨 + 물 미정계수법

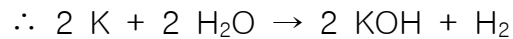


① K : $a = c$

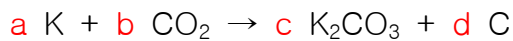
② OH : $b = c$

③ H : $b = 2d \rightarrow d = a/2$

$a \text{ K} + a \text{ H}_2\text{O} \rightarrow a \text{ KOH} + (a/2) \text{ H}_2$ 이므로, 최소의 정수비로 만들기 위해서 a 에 2를 대입



69. 칼륨 + 이산화탄소 미정계수법

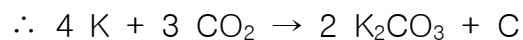


① K : $a = 2c \rightarrow c = a/2$

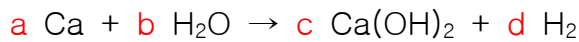
② C : $b = c + d \rightarrow d = a/4$

③ O : $2b = 3c \rightarrow b = 3a/4$

$a \text{ K} + (3a/4) \text{ CO}_2 \rightarrow (a/2) \text{ K}_2\text{CO}_3 + (a/4) \text{ C}$ 이므로, 최소의 정수비로 만들기 위해서 a 에 4를 대입



70. 칼슘 + 물 미정계수법

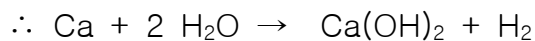


① Ca : $a = c$

② OH : $b = 2c \rightarrow b = 2a$

③ H : $b = 2d \rightarrow d = a$

$a \text{ Ca} + 2a \text{ H}_2\text{O} \rightarrow a \text{ Ca(OH)}_2 + a \text{ H}_2$ 이므로, 최소의 정수비로 만들기 위해서 a 에 1을 대입



71. 탄산마그네슘 산화식 미정계수법

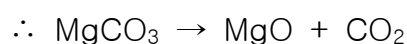


① Mg : $a = b$

② C : $a = c$

③ O : $3a = b + 2c$

$a = b = c$ 이므로 계수는 1이 된다. (최소의 정수비를 맞추어 주기 때문에)



72. 탄산수소나트륨 + 황산 미정계수법



$$\textcircled{1} \text{ Na} : a = 2c \rightarrow c = a/2$$

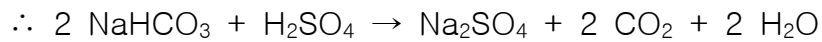
$$\textcircled{2} \text{ H} : a + 2b = 2e$$

$$\textcircled{3} \text{ CO}_2 : a = d$$

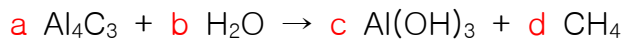
$$\textcircled{4} \text{ O} : a = e$$

$$\textcircled{5} \text{ SO}_4 : b = c \rightarrow b = a/2$$

$a \text{ NaHCO}_3 + (a/2) \text{ H}_2\text{SO}_4 \rightarrow (a/2) \text{ Na}_2\text{SO}_4 + a \text{ CO}_2 + a \text{ H}_2\text{O}$ 이므로, 최소의 정수비로 만들기 위해서 a 에 2를 대입



73. 탄화알루미늄 + 물



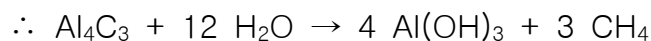
$$\textcircled{1} \text{ Al} : 4a = c$$

$$\textcircled{2} \text{ C} : 3a = d$$

$$\textcircled{3} \text{ OH} : b = 3c$$

$$\textcircled{4} \text{ H} : b = 4d \rightarrow b = 12a$$

$a \text{ Al}_4\text{C}_3 + 12a \text{ H}_2\text{O} \rightarrow 4a \text{ Al(OH)}_3 + 3a \text{ CH}_4$ 이므로, 최소의 정수비로 만들기 위해서 a 에 1을 대입



74. 탄화칼슘 + 물 미정계수법



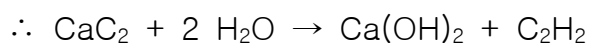
$$\textcircled{1} \text{ Ca} : a = c$$

$$\textcircled{2} \text{ C} : 2a = 2d \rightarrow a = d$$

$$\textcircled{3} \text{ OH} : b = 2c$$

$$\textcircled{4} \text{ H} : b = 2d \rightarrow b = 2a$$

$a \text{ CaC}_2 + 2a \text{ H}_2\text{O} \rightarrow a \text{ Ca(OH)}_2 + a \text{ C}_2\text{H}_2$ 이므로, 최소의 정수비로 만들기 위해서 a 에 1을 대입



75. 트리니트로톨루엔 분해식 미정계수법



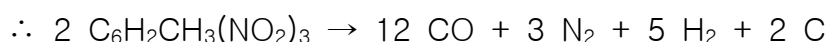
$$\textcircled{1} \text{ C} : 7a = b + e \rightarrow e = a$$

$$\textcircled{2} \text{ H} : 5a = 2d \rightarrow d = 5a/2$$

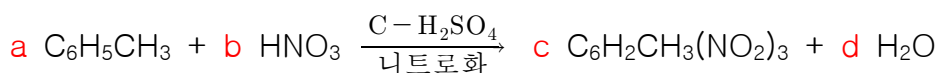
$$\textcircled{3} \text{ N} : 3a = 2c \rightarrow c = 3a/2$$

$$\textcircled{4} \text{ O} : 6a = b$$

$a \text{ C}_6\text{H}_2\text{CH}_3(\text{NO}_2)_3 \rightarrow 6a \text{ CO} + (3a/2) \text{ N}_2 + (5a/2) \text{ H}_2 + a \text{ C}$ 이므로, 최소의 정수 비로 만들기 위해서 a 에 2를 대입



76. 트리니트로톨루엔 제조 미정계수법



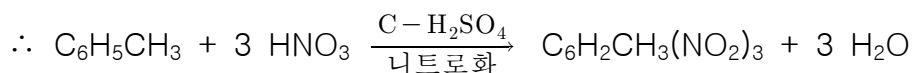
$$\textcircled{1} \text{ C}_6\text{H}_2\text{CH}_3 : a = c$$

$$\textcircled{2} \text{ H} : 3a + b = 2d$$

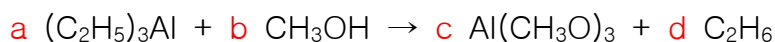
$$\textcircled{3} \text{ NO}_2 : b = 3c \rightarrow b = 3a$$

$$\textcircled{4} \text{ O} : b = d \rightarrow d = 3a$$

$a \text{ C}_6\text{H}_5\text{CH}_3 + 3a \text{ HNO}_3 \rightarrow a \text{ C}_6\text{H}_2\text{CH}_3(\text{NO}_2)_3 + 3a \text{ H}_2\text{O}$ 이므로, 최소의 정수비로 만들기 위해서 a 에 1을 대입



77. 트리에틸알루미늄 + 메틸알코올 미정계수법



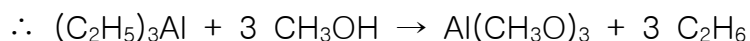
$$\textcircled{1} \text{ C}_2\text{H}_5 : 3a = d$$

$$\textcircled{2} \text{ Al} : a = c$$

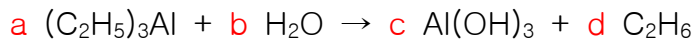
$$\textcircled{3} \text{ CH}_3\text{O} : b = 3c \rightarrow b = 3a$$

$$\textcircled{4} \text{ H} : b = d$$

$a (\text{C}_2\text{H}_5)_3\text{Al} + 3a \text{ CH}_3\text{OH} \rightarrow a \text{ Al}(\text{CH}_3\text{O})_3 + 3a \text{ C}_2\text{H}_6$ 이므로, 최소의 정수비로 만들기 위해서 a 에 1을 대입

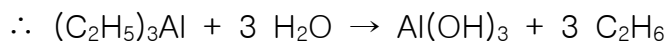


78. 트리에틸알루미늄 + 물 미정계수법



- ① C₂H₅ : $3a = d$
- ② Al : $a = c$
- ③ OH : $b = 3c \rightarrow b = 3a$
- ④ H : $b = d$

$a (\text{C}_2\text{H}_5)_3\text{Al} + 3a \text{H}_2\text{O} \rightarrow c \text{Al}(\text{OH})_3 + 3a \text{C}_2\text{H}_6$ 이므로, 최소의 정수비로 만들기 위해서 a에 1을 대입

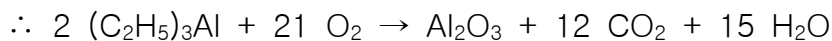


79. 트리에틸알루미늄 연소식 미정계수법

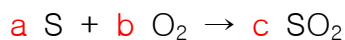


- ① C : $6a = d$
- ② H : $15a = 2e \rightarrow e = 15a/2$
- ③ Al : $a = 2c \rightarrow c = a/2$
- ④ O : $2b = 3c + 2d + e \rightarrow 2b = (3a/2) + 12a + (15a/2) \rightarrow b = 21a/2$

$a (\text{C}_2\text{H}_5)_3\text{Al} + (21a/2) \text{O}_2 \rightarrow (a/2) \text{Al}_2\text{O}_3 + 6a \text{CO}_2 + (15a/2) \text{H}_2\text{O}$ 이므로, 최소의 정수비로 만들기 위해서 a에 2를 대입

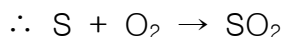


80. 황 + 산소 미정계수법

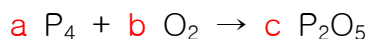


- ① S : $a = c$
- ② O : $2b = 2c \rightarrow b = c$

$a = b = c$ 이므로 계수는 1이 된다. (최소의 정수비를 맞추어 주기 때문에)



81. 황린 연소식 미정계수법



- ① P : $4a = 2c \rightarrow c = 2a$
- ② O : $2b = 5c \rightarrow b = 5a$

$a \text{P}_4 + 5a \text{O}_2 \rightarrow 2a \text{P}_2\text{O}_5$ 이므로, 최소의 정수비로 만들기 위해서 a에 1을 대입

