

Periodic Table of the Elements

1 H 1.00794																1 H 1.00794	2 He 4.002602
3 Li 6.941	4 Be 9.012182											5 B 10.811	6 C 12.0107	7 N 14.00674	8 O 15.9994	9 F 18.9984032	10 Ne 20.1797
11 Na 22.989770	12 Mg 24.3050											13 Al 26.981538	14 Si 28.0855	15 P 30.973761	16 S 32.066	17 Cl 35.4527	18 Ar 39.948
19 K 39.0983	20 Ca 40.078	21 Sc 44.955910	22 Ti 47.867	23 V 50.9415	24 Cr 51.9961	25 Mn 54.938049	26 Fe 55.845	27 Co 58.933200	28 Ni 58.6934	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	32 Ge 72.61	33 As 74.92160	34 Se 78.96	35 Br 79.904	36 Kr 83.80
37 Rb 85.4678	38 Sr 87.62	39 Y 88.90585	40 Zr 91.224	41 Nb 92.90638	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.90550	46 Pd 106.42	47 Ag 107.8682	48 Cd 112.411	49 In 114.818	50 Sn 118.710	51 Sb 121.760	52 Te 127.60	53 I 126.90447	54 Xe 131.29
55 Cs 132.90545	56 Ba 137.327	57 La 138.9055	72 Hf 178.49	73 Ta 180.9479	74 W 183.84	75 Re 186.207	76 Os 190.23	77 Ir 192.217	78 Pt 195.078	79 Au 196.96655	80 Hg 200.59	81 Tl 204.3833	82 Pb 207.2	83 Bi 208.98038	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89 Ac (227)	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (262)	108 Hs (265)	109 Mt (266)	110 (269)	111 (272)	112 (277)		114 (289) (287)		116 (289)		118 (293)

58 Ce 140.116	59 Pr 140.90765	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.964	64 Gd 157.25	65 Tb 158.92534	66 Dy 162.50	67 Ho 164.93032	68 Er 167.26	69 Tm 168.93421	70 Yb 173.04	71 Lu 174.967
90 Th 232.0381	91 Pa 231.03588	92 U 238.0289	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (262)

S.E. Van Bramer, 7/22/99

1995 IUPAC masses and Approved Names from <http://www.chem.qmw.ac.uk/iupac/AtWt/>
masses for 107-111 from C&EN, March 13, 1995, P 35

112 from <http://www.gsi.de/z112e.html>

114 from C&EN July 19, 1999

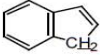
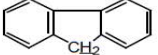
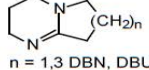

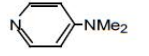
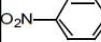
116 and 118 from <http://www.lbl.gov/Science-Articles/Archive/elements-116-118.html>

OTS pKa, buffers, acid-base & UV tables

HI, HBr, HCl, HClO ₄ , HNO ₃ , H ₂ SO ₄			pKa
hydronium	H ₃ O ⁺	H ₂ O	-1,74
chlorique	HClO ₃	ClO ₃ ⁻	-1
trichloroéthanoïque	CCl ₃ COOH	CCl ₃ COO ⁻	0,7
oxalique	HOCCOOH	HOCCOO ⁻	1,3
sulfureux	H ₂ SO ₃	H ₂ SO ₃ ⁻	1,8
hydrogénosulfate	HSO ₄ ⁻	SO ₄ ²⁻	2
phosphorique	H ₃ PO ₄	H ₂ PO ₄ ⁻	2,12
chloroéthanoïque	CH ₂ ClCOOH	CH ₂ ClCOO ⁻	2,86
hexaqua fer(III)	Fe(H ₂ O) ₆ ³⁺	Fe(OH)(H ₂ O) ₅ ²⁺	3
fluorhydrique	HF	F ⁻	3,17
cyanique	HOCN	OCN ⁻	3,66
méthanoïque	HCOOH	HCOO ⁻	3,75
lactique	CH ₃ CHOHCOOH	CH ₃ CHOHCOO ⁻	3,86
benzoïque	C ₆ H ₅ COOH	C ₆ H ₅ COO ⁻	4,2
anilinium	C ₆ H ₅ NH ₃ ⁺	C ₆ H ₅ NH ₂	4,62
éthanoïque	CH ₃ COOH	CH ₃ COO ⁻	4,75
propanoïque	CH ₃ CH ₂ COOH	CH ₃ CH ₂ COO ⁻	4,87
hexaqua aluminium(III)	Al(H ₂ O) ₆ ³⁺	Al(OH)(H ₂ O) ₅ ²⁺	4,95
pyridinium	C ₅ H ₅ NH ⁺	C ₅ H ₅ N	5,16
hydroxylammonium	NH ₂ OH ⁺	NH ₂ OH	6
dioxyde de carbone	CO ₂ + H ₂ O	HCO ₃ ⁻	6,35
sulfhydrique	H ₂ S	HS ⁻	7
dihydrogénophosphate	H ₂ PO ₄ ⁻	HPO ₄ ²⁻	7,2
hypochloreux	HClO	ClO ⁻	7,3
ammonium	NH ₄ ⁺	NH ₃	9,2
borique	H ₃ BO ₃	H ₂ BO ₃ ⁻	9,23
cyanhydrique	HCN	CN ⁻	9,31
anilinium	C ₆ H ₅ NH ₃ ⁺	C ₆ H ₅ NH ₂	9,37
triméthylammonium	(CH ₃) ₃ NH ⁺	(CH ₃) ₃ N	9,9
phénol	C ₆ H ₅ OH	C ₆ H ₅ O ⁻	10
hydrogénocarbonate	HCO ₃ ⁻	CO ₃ ²⁻	10,32
éthylammonium	C ₂ H ₅ NH ₃ ⁺	C ₂ H ₅ NH ₂	10,67
méthylammonium	CH ₃ NH ₃ ⁺	CH ₃ NH ₂	10,72
diméthylammonium	(CH ₃) ₂ NH ₃ ⁺	(CH ₃) ₂ NH	11,02
hydrogénophosphate	HPO ₄ ²⁻	PO ₄ ³⁻	12,3
hydrogénosulfure	HS ⁻	S ²⁻	15
eau	H ₂ O	OH ⁻	15,74

Buffers	Conc, NTP	pH
Sat NH ₄ Cl	~0.7M	~4.5
Sat NaHCO ₃	~0.9M	~8
10% KH ₂ PO ₄	0.75M	~3.6

Acid/Base	wt %	p (g/mL)	MW	mL=>1M
Conc H ₃ PO ₄ : 22M	85%	1.69	98	45
Conc H ₂ SO ₄ : 18M	95-98%	1.84	98	56
Glacial AcOH : 17.5M	99.7%	1.05	60	57
Conc HNO ₃ : 16M	68-70%	1.41	63	63
Conc HCl : 12M	36-38%	1.18	36.5	83
Conc NaOH : 19M	50%	1.53	40	53
Conc NH ₄ OH : 15M	28-30%	0.90	35	67
Conc KOH : 11.7M	45%	1.45	57	85

Acid	pKa	Acid	pKa	Base	pKa (of conj. acid)
CH ₂ (NO ₂) ₂	4	(CH ₃) ₃ COH	19	BuLi	45
CH ₃ CO ₂ H	5	PhCOCH ₃	19	RMgBr	45
Ph ₃ P ⁺ CH ₂ CO ₂ Et	6	CH ₃ COCH ₃	20	PhLi	40
(CH ₃) ₂ CHNO ₂	8		20	NaH/KH	~37
NCCH ₂ CO ₂ Et	9	Ph ₂ NH	21	R ₂ NLi	36
CH ₃ CH ₂ NO ₂	9	(CH ₃) ₃ CCOCH ₃	21	NH ₂ ⁻	35
CH ₃ NO ₂	10		23	CH ₃ SOCH ₂ Na ⁺	35
PhOH	10	Me ₃ NH ⁺	10	Ph ₃ C ⁻	31
Me ₃ NH ⁺	10	CH ₃ SO ₂ CH ₃	23-7	tBuO ⁻	19
CH ₃ COCH ₂ CO ₂ Et	11	CH ₃ CO ₂ Et	25	EtO ⁻	18
CH ₃ CH(COCH ₃) ₂	11	CH ₃ CN	25	MeO ⁻	17
CH ₂ (CN) ₂	11	H-C≡C-H	25	HO ⁻	16
CH ₃ SH	12	PhNH ₂	27	Na ₂ CO ₃	12
CH ₂ (CO ₂ Et) ₂	13	Ph ₃ CH	31		11-13
	15	Ph ₂ CH ₂	33	n = 1, 3 DBN, DBU	
H ₂ O	16	CH ₃ SOCH ₃	35		10-12
PhCH ₂ COPh	16	NH ₃	35	PhO ⁻	10
O ₂ N-  -NHPh	16	(CH ₃ CH ₂) ₂ NH	36	R ₃ N	10
CH ₃ OH	17	[(CH ₃) ₂ CH] ₂ NH	36	ImH	7
CH ₃ COCH ₂ Cl	17	PhCH ₃	37	NaHCO ₃	7
CH ₃ CH ₂ OH	18	CH ₂ =CH-CH ₃	38	PhNET ₂	6
(CH ₃) ₂ CHOH	18	PhH	40	pyridine	5
CH ₃ PPh ₃	18	R-H	45-52	AcO ⁻	5

Phenyl-	H	NH ₃ ⁺	Cl	CH ₃	CO ₂ ⁻	OCH ₃	OH	CN	CO ₂ H	COR	CCH	NH ₂	CHO	NO ₂	C=CH ₂	O ⁻
λ _{max}	254	254	260	261	268	269	270	271	273	276	278	280	280	280	282	287
ε	204	169	190	225	560	1480	1450	1000	970	800	6500	1430	1400	1000	740	2600

Alumina:	%H ₂ O to add to	Approx water %
Brockmann #	Br.# I	
II	3	4-4.5
III	6	7-7.5
IV	10	11-11.5
V	15	16-16.5

For Br. II-V grades, shake grade I (disintegrate lumps) w H₂O, equilibrate in closed vessel o/n.
See Fieser and Fieser, *Reagents for Organic Synthesis* for use in synthesis

Brock Grades I (1.5% H ₂ O), pH @5% aq susp; mesh 150 = 0.10mm sieve, 58Å pore, 150m ² g ⁻¹ .				
Grade	5016-A	507-C	504-C	504-C
Type	basic	neutr	acid	wk acid
pH	9.5	7.5	4.5	6.0

OTS DRY SOLVENT TABLE	Initial	3 Å MS 24 {72}h 5 (10) [20]% m/v	4Å MS 24 [72] h 5-10% m/v	SiO ₂ (28-200) 22 Å, col	act. neutr Al ₂ O ₃	CaH ₂ 24h	KOH 10% 24h	P ₂ O ₅	Refs	Notes
Benzene	100		0.03	0.3	0.01	0.2 d			2	15 frac dist
Toluene	225	(1)	0.01	2					1,4	31 Na / benzo
DCM	22	(0,1)	0.07	1		13 d			1,4	
EtOAc	2500		128						4	
THF	108	(28) [15] 6 seq	28 seq ex 1000	56	6				1	43 Na / benzo
Dioxane	2300	19	40 [30]	1300	1700	30 nd	150 nd		2, 3	
Acetone	2750	150 c! iot	331 c! iot	887 c!				c!	3	Base ^H ₂ O; +B ₂ O ₃ : 107
MeCN	2800	50; seq 0.5	[450]	1300	1600 (6 pd)	1900 nd	2200 n/d, c	9 nd	2,1	Base degrad (K ₂ CO ₃)
DMF	2860	167 {98; 1.5 seq}	134		1970	227nd, 94d	1100 p	105nd, 2d	3	
DMSO	2560	448 {269; seq+}	470 [10 seq]		1900	1800 d	2130 n/d, c	1.4 c	3	260 frac dist
MeOH	1100	95 b, 10 seq3; 950p!	440			125 nd	pd? 33 d ¹		3,1	Mg / I ₂ : 97, pd54, (12+)
EtOH	1500	18 p, 262 b [120]; 8 wk	400			99 nd	26 d; - nd ³		1>3	Mg / I ₂ : 50
tBuOH	1030	428; 160 wk	406			20 d; 406 nd				
Glycol	2700	1900; 360p	1900						3	1080 dist; 65 benz azeo
py	2500	117	106 (0.3 seq)	900	1300	39 nd	156 p		3	
2pyMe	2500	55				84 nd	176 p		3	40 benz azeo
2,6pyMe ₂	2500	200	250 (128 seq)			250 nd	325 p		3	
2,4,6pyMe ₃	2500	47				130 nd	27 p		3	
NEt ₃	2500	33	33	451	223	68	37 p		3	
iPr ₂ NH	2500	<25	<25			150	750 p		3	
1,3-diamprop	2500	<25	<25			500	1370 p!		3	
Et ₂ O	1.47wt% H ₂ O if saturated; @ 15min, Na ₂ SO ₄ 1.2%, 4Å b 0.5%, K ₂ CO ₃ 0.4%, MgSO ₄ 0.3%, CaCl ₂ 0.2%, 4Å p 900ppm. Then seq 4Å: 2ppm by 96h.									

Abbreviations

d	distilled
nd	not distilled
c	contaminates even distillate
n/d	distilled or not
p	powder
b	beads
pl	pellet
seq	sequentially dried
+	see ref for better tech
wk	one week drying time
iot	increases over time
ex	from a different init conc

Refs

- 1: Bradley JOC, 2010, 75 (24), pp 8351–8354
- 2: Burfield et al., JOC 1977, 42, 3060.
- 3: Burfield: JOC 1981, 46, 629; JOC 1978, 43, 3966; JOC 1984, 49, 3852; JOC 1983, 48, 2420 ; J. Chem. Educ. 1982, 59, 703.
- 4: Burfield et al., Journal of Applied Chemistry and Biotechnology 1978, 28, 23.

Table II. Desiccant Efficiency in the Drying^a of Various Amines^b

desiccant	residual water content, ppm		
	Et ₃ N ^d	(Me ₂ CH) ₂ NH ^e	NH ₂ (CH ₂) ₂ NH ₂ ^e
KOH powder	37 (28) ^f	750 ^g	1370 (3700) ^g
4A sieves	33 (28) ^h	<25	<25
3A sieves	34	<25	<25
CaH ₂	68 (34) ^f	150 ⁱ	500 ⁱ
Na	88	<25	150
BaO	89 (53) ^f	50	1100
CaC ₂	98 (80) ^f	<25 ⁱ	<25 ⁱ
CaO	165 (56) ^f		
Al ₂ O ₃	223 (223) ^f		
silica gel	451		
CaSO ₄		>2500	

Table II. Efficiency of Desiccants in the Drying^a of DMF^b

desiccant	residual solvent water content, ppm			
	6 h	24 h	72 h	other conditions
3A molecular sieves	500	167	98	1.5 ^c
P ₂ O ₅	879	105	578	2 ^d
CaH ₂	641	227	102	94 ^d
4A molecular sieves	454	134	108	
KOH (powdered)	1360	1110		303 ^d 890 ^e
B ₂ O ₃				
BaO	2060	1520	1140	
CaO	2090			
Al ₂ O ₃	1970			
CaSO ₄	2310	2030	1420	
K ₂ CO ₃	2500			

^a Static drying modes unless otherwise specified. ^b Desiccant loading 5% w/v; initial water content 2860 ppm (0.286% w/w). ^c Sequentially dried sample, 72 h. ^d Distilled Sample. ^e Stirring for 24 h followed by distillation.

Table IV. Efficiency of Desiccants in the Drying^a of Acetone^b

desiccant	residual solvent water content, ppm			
	6 h	24 h	72 h	other conditions
B ₂ O ₃				18 ^{c,d} 47 ^{c,e} 107 ^f
3A molecular sieves	115	152	322 ^e	322 ^h
CuSO ₄ (anhydrous)	1920	972	578	1700 ^h
4A molecular sieves	331	887	1720	
CaSO ₄	1590	1800		
BaO	1910	1870 ^f		
P ₂ O ₅				1970 ^f
K ₂ CO ₃	2057	2250		

^a Static drying modes unless specified otherwise. ^b Desiccant loading 5% w/v; initial water content 2710 ppm (0.271% w/w), unless specified otherwise. ^c Initial water content 2890 ppm (0.289% w/w). ^d Stirred, distilled, and sequentially dried, 24 h. ^e Stirred for 24 h and distilled. ^f Dried for 24 h and then distilled. ^g Contamination (2%) by mesityl oxide. ^h Fractionated sample. ⁱ Contamination (12%) by mesityl oxide. ^j Brown-black solution.

Table V. Comparison of Desiccant Drying Efficiency for Dioxane and Acetonitrile^a

desiccant	residual solvent water content, ppm	
	dioxane	acetonitrile
CaSO ₄ ^b	240	180
CaCl ₂ ^b	290	d
3A molecular sieve ^c	19	52
4A molecular sieve ^c	30	450

^a Initial water content = 2500 ppm; drying time 72 h. Activation temperature: ^b = 225 °C. ^c = 350 °C. Drying temperature 27-30 °C. ^d CaCl₂ induces a base-catalyzed tritium exchange with acetonitrile which precludes determination; desiccant loading = 5% w/v.

Table II. Desiccant Efficiency in Drying^{a,b} of 1,2-Ethanedithiol^c

desiccant	residual water content, ppm
3A sieves (bead)	1900 (1200, 540) ^d
3A sieves (powder)	360 ^f
4A sieves (powder)	1900 (2070) ^d
MgSO ₄	3600
CaC ₂	990 ^g
B ₂ O ₃	h
BaO	h
CaO	k
distillation ^h	1080
benzene azeotrope	65 ^{h,i} (76) ^{h,j}
Mg	150 (76) ^{h,k}
Al	400

^a Static drying modes unless specified otherwise. ^b Water content assayed by the Karl Fischer method. ^c Initial water content 1500 ppm. ^d Initial water content 1010 ppm. ^e Initial water content 1030 ppm. ^f 96-h drying period. ^g 168-h drying period. ^h Analysis was performed after settling of desiccant, 3-6 h. ⁱ Weight of magnesium in accord with general practice, i.e., 0.5% w/v. ^j See text. ^k Weight of magnesium 2% w/v. ^l Distilled sample. ^m Initial water content 1670 ppm, distilled sample. ⁿ Weight of sodium 3% w/v. See ref 32. ^o Ratio of sodium to 2-butyl succinate for 2-BuOH and diethyl phthalate for ethanol in accord with general practice (see ref 7c), i.e., Na, 0.3 mol L⁻¹; dicarboxylic acid ester, 0.14 mol L⁻¹. ^p Stirred sample. ^q No apparent drying.

Table III. Efficiency of Desiccants in the Drying^a of Me₂SO^b

desiccant	residual solvent water content, ppm		
	6 h	24 h	72 h
4A molecular sieves	978	471	332
3A molecular sieves	1050	448	269
none			
P ₂ O ₅			
B ₂ O ₃			
CaH ₂	1560		1820
BaO	1450	1330	1770
CaO	2060		1740
Al ₂ O ₃	1840	1900	1920
K ₂ CO ₃	2280	2200	
KOH (powdered)	2130 ^h		
CaSO ₄	2140		

^a Static drying modes unless otherwise specified. ^b Desiccant loading 5% w/v; sequentially dried sample, 72 h. ^c Fractionally distilled sample. ^d Distilled sample. ^e C for 24 h followed by distillation. ^f Yellow colored solutions.

Agent	Capacity ^a	Speed ^b	Comments
CaSO ₄	1/2 H ₂ O	Very fast (1)	Sold commercially as "Drierite" with or without a color indicator; very efficient. When dry the indicator (CoCl ₂) is blue, but turns pink as it takes on H ₂ O (capacity CoCl ₂ ·6H ₂ O); useful in temperature range -50° to +85°. Some organic solvent leach out, or change the color of CoCl ₂ (acetone, alcohols, pyridine, etc.).
CaCl ₂	6 H ₂ O	Very fast (2)	Not very efficient; use only for hydrocarbons and alkyl halides (forms solvates, complexes, or reacts with many N and O compounds).
MgSO ₄	7 H ₂ O	Fast (4)	Excellent general agent; very inert but may be slightly acidic (avoid with very acid-sensitive compounds). May be soluble in some organic solvents.
Molecular Sieve 4A	High	Fast (30)	Very efficient; predrying with a more common agent recommended. (see below for details on molecular sieves). Sieve 3A also excellent.
Na ₂ SO ₄	10 H ₂ O	Slow (290)	Very mild, inefficient, slow, inexpensive, high capacity; good for gross predrying, but do not warm the solution.
K ₂ CO ₃	2 H ₂ O	Fast	Good for esters, nitriles, ketone and especially alcohols; do not use with acidic compounds.
NaOH, KOH	Very high	Fast	Powerful, but used only with inert solutions in which agent is insoluble; especially good for amines.
H ₂ SO ₄	Very high	Very fast	Very efficient, but use limited to saturated or aromatic hydrocarbons or halides (will remove olefins and other "basic" compounds).

Table I. Desiccant Efficiency in the Drying^{a,b} of a Pyridine^c Series

desiccant	residual water content, ppm			
	pyridine	2-methylpyridine	2,6-dimethylpyridine	2,4,6-trimethylpyridine
CaH ₂	39 (14) ^e	84	248 (138) ^e	132
CaC ₂	44 (10) ^e	71	519	8
BaO	101	27	360	33
4A sieves	106 (0.3) ^f		268 (126)	
3A sieves	117	55	200 (128)	47
benzene azeotrope	125	40	207	390
KOH powder	152	176	325	27
Na	388			
CaO	962		935	
silica gel	926			
Al ₂ O ₃	1306			

^a Static drying modes unless specified otherwise. ^b Water content assayed by the radiotracer technique. ^c Desiccant loading 5% w/v; initial water content 2500 ppm (0.25% w/w). ^d 24-h drying times unless specified otherwise. ^e 168-h drying time. ^f Sequentially dried sample, 24 h.

Table I. Desiccant Efficiency in Drying^{a,b} of Some Common Lower Alcohols^c

desiccant	residual water content, ppm			
	methanol ^d	ethanol ^e	2-butanol ^f	tert-butyl alcohol ^g
3A sieves (bead)	95	99	645 (9) ^h	428 (160) ⁱ
3A sieves (powder) ^j	940	18	14	13
MgI ₂ ^k	97 (12) ^l	50 (53) ^m		
CaH ₂	125	99	17 ⁿ	406 (20) ^o
Na ^p		1800 ⁿ	2400 ⁿ	406 (10) ^o
Na/dicarboxylic acid ester ^q		92 ⁿ	36 ⁿ	
4A sieves (bead)	440	401		406
5A sieves (bead)	475	875		
CaC ₂	490	338 (199) ^r	409	430 ⁿ (662) ^o
BaO	1000			
Ca	1000			860
K ₂ CO ₃				760
CaO				770
KOH powder				
ion exchange resin				640

^a Static drying modes unless specified otherwise. ^b Water content assayed by the Karl Fischer method. ^c Desiccant loading 5% w/v with a drying period of 24 h unless specified otherwise. ^d Initial water content 1010 ppm. ^e Initial water content 1500 ppm. ^f Initial water content 1000 ppm. ^g Initial water content 1030 ppm. ^h 96-h drying period. ⁱ 168-h drying period. ^j Analysis was performed after settling of desiccant, 3-6 h. ^k Weight of magnesium in accord with general practice, i.e., 0.5% w/v. ^l See text. ^m Weight of magnesium 2% w/v. ⁿ Distilled sample. ^o Initial water content 1670 ppm, distilled sample. ^p Weight of sodium 3% w/v. See ref 32. ^q Ratio of sodium to 2-butyl succinate for 2-BuOH and diethyl phthalate for ethanol in accord with general practice (see ref 7c), i.e., Na, 0.3 mol L⁻¹; dicarboxylic acid ester, 0.14 mol L⁻¹. ^r Stirred sample. ^s No apparent drying.

III. Dependence of Drying Efficiency on Desiccant Loading in the Drying of Grossly Wet Diethyl Ether^a

desiccant	desiccant loading % w/v	residual solvent water content, ppm					capacity ^d % w/w
		5 min	15 min	30 min	60 min	360 min	
CaSO ₄	10 ^b		11400	9200	10200	10700	2.8-3.8
	20 ^b	6400	3800	2100			4.5
	20 ^c	9700	7500	5800			3.1
CaCl ₂	5 ^c		2400	2100	2100	850	19.6
	10 ^c		2100	2100	1900	390	10.1
	20 ^c	2100	1400	900			4.9

^a Initial water content = 14700 ppm; drying temperature = 22 °C. Activation temperature: ^b = 220 °C. ^c = 350 °C. ^d Given by weight of water absorbed per unit of desiccant expressed as a percentage.

<i>OTS Elutropic Series</i>	Dielec Const (€)	Dipole Moment (Debye)	bp 1 bar (°C)	Vap p NTP (mbar)	ρ mg/mL	MW (Da)	mp (°C)	Sol in 100g H ₂ O	H ₂ O Sol in 100g
Water	78.3	1.85	100	32	998.2	18.012	0	-	-
Acetic Acid	6.15	1.74	118	15	1049	60.052	16.5	misc	misc
Methanol	33.6	1.7	65	169	791.4	32.042	-98	misc	misc
Ethanol	24.3	1.69	79	79	789.3	46.068	-115	misc	misc
Isopropanol	18.3	1.66	83	58	786	60.095	-88	misc	misc
Pyridine	12.3	2.28	115	20	981.9	79.101	-42	misc	misc
Acetonitrile	3.88	3.92	82	119	785.9	41.052	-44	misc	misc
Dimethylsulfoxide	47	3.96	189	0.8	1101	78.133	18	misc	misc
Ethyl acetate	6.02	0.44	77	98	900.3	88.105	-84	8.3	3.3
Dioxane	2.21	0.45	101	45	1033	88.105	12	misc	misc
Acetone	20.7	2.88	56	308	784.5	58.079	-95	misc	misc
Tetrahydrofuran	7.58	1.75	65	216	883.3	72.106	-108	misc	misc
Dichloromethane	9.14	1.6	40	582	1327	84.933	-97	1.3	0.2
Chloroform	4.87	1.04	61	262	1479	119.378	-63	0.8	0.07
Diethyl ether	4.34	1.15	34.5	717	713.8	74.121	-116	7.5	1.3
Benzene	2.28	0	80	127	876.5	78.122	5.5	0.2	?
Toluene	2.38	0.37	111	38	866.8	92.139	-95	0.05	?
Carbon tetrachloride	2.2	0	77	152	1594	153.8	-23	0.08	0.01
Cyclohexane	2.02	0	81	130	773.9	84.159	6.6	<0.1	<0.1
Petroleum ether	-2	0	~40-60	-500	~650	-80	~ -130	?	?
n-Hexane	1.89	0	69	202	660.6	86.175	-96	0	0
n-Pentane	1.84	0	36	533	626.2	72.149	-130	?	?

Other

Methyl <i>t</i> -butyl ether	2.6	1.32	55	336	735.3	88.148	-109	?	?
Dimethylformamide	36.7	3.82	153	4	944.5	73.094	-61	misc	misc
1,2-dichloroethane	10.5	1.8	84	106	1176	98.959	-97	0.87	?
Triethylamine		0.7?	89	72	727.5	101.190	-115	13.3	?
Dimethylacetamide	37.8	3.72	165	1.8	0.9372	87.120	-19	?	?
<i>t</i> -Butanol	12.4	1.7	82	?	0.7812	74.12	26	misc	misc

ligroin: C₇C₁₁ @ 60-90°C: 55% alk, 30% cycloalk, 12% alkylbenz, 2% dicycloalk

Magic Eluants

1 - 1:10:90 NH₄OH : MeOH : DCM

2 - 80:10:5:5 EtOAc : nBuOH : H₂O : AcOH

Frozen Joints:

a) freeze, acetone, heat

b) 10:5:5:3 chloral hydrate, glycerine, water, conc HCl

TABLE 7 (continued). MATERIALS FOR COOLING BATHS

-52°	Benzyl acetate or diethylcarbitol
-55°	Diacetone
-56°	n-Octane
-60°	Isopropyl ether
-73°	Trichloroethylene or isopropyl acetate
-74°	o-Cymene or p-cymene
-77°	Butyl acetate
-79°	Isoamyl acetate
-83°	Propylamine

By using liquid nitrogen* instead of solid CO₂, this range can be extended.

-83.6°	Ethyl acetate ³
-86°	Methyl ethyl ketone
-89°	n-Butanol
-90°	Nitroethane
-91°	Heptane
-92°	n-Propyl acetate
-93°	2-Nitropropane or cyclopentane
-94°	Ethyl benzene or hexane
-94.6°	Acetone
-95.1°	Toluene
-97°	Cumene
-98°	Methanol or methyl acetate
-99°	Isobutyl acetate
-104°	Cyclohexane
-107°	Isooctane
-108°	1-Nitropropane
-116°	Ethanol or ethyl ether ⁴
-117°	Isoamyl alcohol
-126°	Methylcyclohexane
-131°	n-Pentane
-160°	Isopentane

For other organic materials used in low temperature slush-baths with liquid N₂, see Chem. Eng. Data 11 124 1966. NOTE that the liquid nitrogen should be a hat has been in contact with air will contain oxygen (see Table 8 for boiling point).

Use high quality pure nitrogen, do not use liquid air or liquid nitrogen if it has been in contact with air will contain oxygen (see Table 8 for boiling point). If the quality of the liquid nitrogen is not known, or is un-

TABLE 7. MATERIALS FOR COOLING BATHS

Temperature	Composition
0°	Crushed ice
-5° to -20°	Ice-salt mixtures
-33°	Liquid ammonia
-40° to -50°	Ice (3.5-4 parts) - CaCl ₂ ·6H ₂ O (5 parts)
-72°	Solid CO ₂ with ethanol
-77°	Solid CO ₂ with chloroform or acetone
-78°	Solid CO ₂ (powdered)
-100°	Solid CO ₂ with ethyl ether
-192°	Liquid air
-196°	Liquid nitrogen

Alternatively, the following liquids can be used, partially frozen, as cryostats, by adding solid CO₂ to the material in a Dewar-type container and stirring to make a slush:

13°	p-Xylene
12°	Dioxane
6°	Cyclohexane
5°	Benzene
2°	Formamide
-8.6°	Methyl salicylate
-9°	Hexane-2,5-dione
-10.5°	Ethylene glycol
-11.9°	tert-Amyl alcohol
-12°	Cycloheptane or methyl benzoate
-15°	Benzyl alcohol
-16.3°	n-Octanol
-18°	1,2-Dichlorobenzene
-22°	Tetrachloroethylene
-22.4°	Butyl benzoate
-22.8°	Carbon tetrachloride
-24.5°	Diethyl sulphate
-25°	1,3-Dichlorobenzene
-29°	o-Xylene or pentachloroethane
-30°	Bromobenzene
-32°	m-Toluidine
-32.6°	Dipropyl ketone
-38°	Thiophene
-41°	Methyl cyanide
-42°	Pyridine or diethyl ketone
-44°	Cyclohexyl chloride
-45°	Chlorobenzene
-47°	m-Xylene
-50°	Ethyl malonate or n-butylamine

TABLE 5.

Acetic acid (118°)	Ethyl acetate (78°)
(glacial)	Ethyl benzoate (98°/19mm)
Acetone (56°)	Ethylene glycol (68°/4mm)
Acetylacetone (139°)	Formamide (110°/10mm)
Benzene (80°)	Glycerol (126°/11mm)
Benzyl alcohol (93°/10mm)	Isoamyl alcohol (131°)
n-Butanol (118°)	Methanol (64.5°)
Butyl acetate (126.5°)	Methyl cyanide (82°)
n-Butyl ether (142°)	Methylene chloride (41°)
γ-Butyrolactone (206°)	Methyl ethyl ketone (80°)
Carbon tetrachloride (77°)	Methyl isobutyl ketone (116°)
Cellosolve (135°)	Nitrobenzene (210°)
Chlorobenzene (132°)	Nitromethane (101°)
Chloroform (61°)	Petroleum ether (various)
Cyclohexane (81°)	Pyridine (115.5°)
Diethyl cellosolve (121°)	Pyridine trihydrate (93°)
Diethyl ether (34.5°)	Tetrahydrofuran (64-66°)
Dimethyl formamide (76°/39mm)	Toluene (110°)
Dioxane (101°)	Trimethylene glycol (59°/11mm)
Ethanol (78°)	Water (100°)

* Highly flammable, should be heated or evaporated on steam or electrically heated water baths only (preferably in a nitrogen atmosphere).

TABLE 6. PAIRS OF MISCIBLE SOLVENTS

Acetic acid: with chloroform, ethanol, ethyl acetate, methyl cyanide, petroleum ether, or water.
Acetone: with benzene, butyl acetate, butyl alcohol, carbon tetrachloride, chloroform, cyclohexane, ethanol, ethyl acetate, methyl acetate, methyl cyanide, petroleum ether or water.
Ammonia: with ethanol, methanol, pyridine.
Aniline: with acetone, benzene, carbon tetrachloride, ethyl ether, n-heptane, methanol, methyl cyanide or nitrobenzene.
Benzene: with acetone, butyl alcohol, carbon tetrachloride, chloroform, cyclohexane, ethanol, methyl cyanide, petroleum ether or pyridine.
Butyl alcohol: with acetone or ethyl acetate.
Carbon disulphide: with petroleum ether.
Carbon tetrachloride: with cyclohexane.
Chloroform: with acetic acid, acetone, benzene, ethanol, ethyl acetate, hexane, methanol or pyridine.
Cyclohexane: with acetone, benzene, carbon tetrachloride, ethanol or ethyl ether.
Dimethyl formamide: with benzene, ethanol or ether.
Dimethyl sulphoxide: with acetone, benzene, chloroform, ethanol, ethyl ether or water.
Dioxane: with benzene, carbon tetrachloride, chloroform, ethanol, ethyl ether, petroleum ether, pyridine or water.
Ethanol: with acetic acid, acetone, benzene, chloroform, cyclohexane, dioxane, ethyl ether, pentane, toluene, water or xylene.
Ethyl acetate: with acetic acid, acetone, butyl alcohol, chloroform, or methanol.
Ethyl ether: with acetone, cyclohexane, ethanol, methanol, methylal, methyl cyanide, pentane or petroleum ether.
Glycerol: with ethanol, methanol or water.
Hexane: with benzene, chloroform or ethanol.
Methanol: with chloroform, ethyl ether, glycerol or water.
Methylal: with ethyl ether.
Methyl ethyl ketone: with acetic acid, benzene, ethanol or methanol.
Nitrobenzene: with aniline, methanol or methyl cyanide.
Pentane: with ethanol or ethyl ether.
Petroleum ether: with acetic acid, acetone, benzene, carbon disulphide or ethyl ether.
Phenol: with carbon tetrachloride, ethanol, ethyl ether or xylene.
Pyridine: with acetone, ammonia, benzene, chloroform, dioxane, petroleum ether, toluene or water.
Toluene: with ethanol, ethyl ether or pyridine.
Water: with acetic acid, acetone, ethanol, methanol, or pyridine.
Xylene: with ethanol or phenol.

E 18. SOME COMMON IMMISCIBLE OR SLIGHTLY MISCIBLE PAIRS OF SOLVENTS

Carbon tetrachloride with ethanolamine, ethylene glycol, formamide or water.
Dimethyl formamide with cyclohexane or petroleum ether.
Dimethyl sulphoxide with cyclohexane or petroleum ether.
Ethyl ether with ethanolamine, ethylene glycol or water.
Methanol with carbon disulphide, cyclohexane or petroleum ether.
Petroleum ether with aniline, benzyl alcohol, dimethyl formamide, dimethyl sulphoxide, formamide, furfuryl alcohol, phenol or water.
Water with aniline, benzene, benzyl alcohol, carbon disulphide, carbon tetrachloride, chloroform, cyclohexane, cyclohexanol, cyclohexanone, ethyl acetate, isoamyl alcohol, methyl ketone, nitromethane, tributyl phosphate or toluene.

Pourquoi utiliser ce

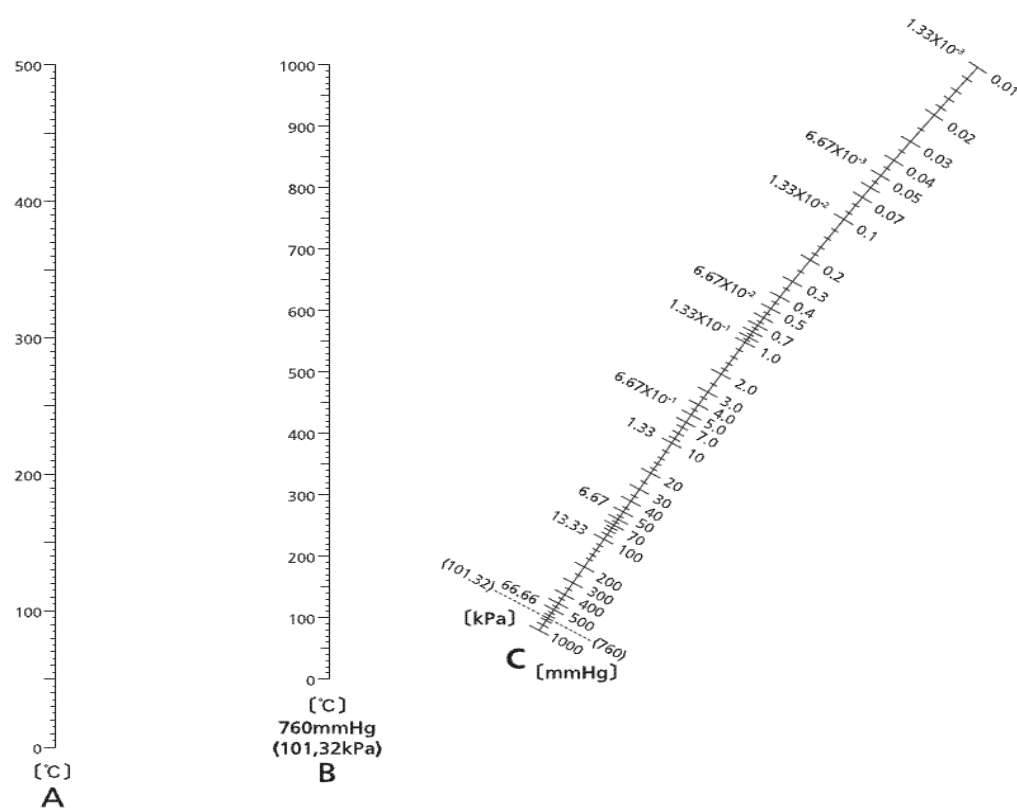
Why use this laboratory notebook?

% X ₁ in H ₂ O ~homoazeo	water + X ₁ bp (°C)	X ₁ bp (°C)
-Phenol, 9 %	99.5	182
-BnOH, 9 %	100	206
HCl, 20 %	108.6	-85
HCOOH, 23 %	107.1	101
HBr, 47 %	126	-73
pyridine, 57 %	93	116
HNO ₃ , 67 %	120.7	86
dioxane, 82 %	88	101
MeCN, 85%	76	82
iPrOH, 87 %	80.3	82.3
tBuOH, 88 %	80	83
THF, 95 %	65	66
EtOH, 96 %	78.2	78.3
H ₂ SO ₄ , 98 %	338	290

% X ₁ in H ₂ O heteroazeo	water + X ₁ bp (°C)	X ₁ bp (°C)	% X ₁ in (upper, lower)
m-Xylene, 60 %	95	140	99.9 ; 0.05
toluene, 80 %	84	110	99.95 ; 0.06
Benzene, 91 %	69	80	99.9 ; 0.07
EtOAc, 92 %	70	77	97 ; 9
Cyclohex, 92 %	70	81	99.99 ; 0.01

Water Zeotropes : MeOH, AcOH, acetone.

Water barely-heteroazeotropes (>96%) : CH₂Cl₂, Et₂O, pentane, CHCl₃, iPr₂O, CCl₄



Organic Azeotropes, components < 90%

MeOH: hex, EtOAc, benz, tol, cy, hex, CHCl₃, CCl₄, MeCN, acetone, iPrOH, THF

MeOH has ~20:35:45 ternary azeo, MeOH/acetone/CHCl₃-or-cy

EtOH: EtOAc, benz, cy, tol, hex, CCl₄

iPrOH: EtOAc, benz, tol, cy, CCl₄

AcOH: toluene, pyridine

Benzene: Cy, MeCN

Acetone: CHCl₃, cy

H		Chemical Hardness										He					
12.84												22.49					
12.80												21.57					
Li	Be											B	C	N	O	F	Ne
7.80	10.4											10.98	12.75	14.79	16.38	18.25	22.49
4.77	9.03											8.02	10.00	14.61	12.16	14.02	21.57
Na	Mg											Al	Si	P	S	Cl	Ar
6.73	8.37											7.45	8.51	9.71	10.51	11.76	14.12
4.59	7.10											5.55	6.76	9.74	8.28	9.36	15.76
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
5.33	6.27	5.50	5.98	6.06	6.12	6.20	6.16	7.38	7.28	6.91	8.60	7.28	8.35	8.99	9.53	10.41	12.23
3.84	6.09	6.37	6.75	6.22	6.10	7.93	7.75	7.22	--	6.49	--	5.57	6.67	8.98	7.73	8.45	14.00
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
4.94	5.59	8.31	6.95	7.13	6.33	--	8.01	8.72	8.87	7.04	7.74	6.49	8.12	7.85	8.25	8.89	10.29
3.69	5.64	5.91	6.21	5.87	6.34	--	6.31	6.32	7.78	6.27	--	5.49	6.23	7.56	7.04	7.39	12.13

X
vf(r=0)
Exp. η

- **Acetylenic compounds** can be explosive in mixtures of 2.5 to 80% with air. At pressures of 2 or more atmospheres, acetylene (C_2H_2) subjected to an electrical discharge or high temperature decomposes with explosive violence. Dry acetylides detonate on receiving the slightest shock. **Acetylene must be handled in acetone solution and never stored alone in a cylinder.**
- **Aluminum chloride** ($AlCl_3$) should be considered potentially dangerous. If moisture is present, there may be sufficient decomposition to form hydrogen chloride (HCl) and build up considerable pressure. If a bottle is to be opened after long storage, it should first be completely enclosed in a heavy towel.
- **Ammonia** (NH_3) reacts with iodine to give nitrogen triiodide, which detonates on touch. Ammonia reacts with hypochlorites to give chlorine. Mixtures of NH_3 and organic halides sometimes react violently when heated under pressure. Ammonia is combustible. Inhalation of concentrated fumes can be fatal.
- **Azides**, both organic and inorganic, and some azo compounds can be heat- and shock-sensitive. Azides such as sodium azide can displace halide from chlorinated hydrocarbons such as dichloromethane to form highly explosive organic polyazides; this substitution reaction is facilitated in solvents such as dimethyl sulfoxide (DMSO).
- **Carbon disulfide** (CS_2) is both very toxic and very flammable; mixed with air, its vapors can be ignited by a steam bath or pipe, a hot plate, or a light bulb.
- **Chlorine** (Cl_2) is toxic and may react violently with hydrogen (H_2) or with hydrocarbons when exposed to sunlight.
- **Chromium trioxide-pyridine complex** ($CrO_3 \cdot C_5H_5N$) may explode if CrO_3 concentration is too high. Complex is prepared by addition of CrO_3 to excess C_5H_5N .
- **Diazomethane** (CH_2N_2) and related diazo compounds should be treated with extreme caution. They are very toxic, and the pure gases and liquids explode readily even from contact with sharp edges of glass. Solutions in ether are safer from this standpoint. An ether solution of diazomethane is rendered harmless by drop wise addition of acetic acid.
- **Diethyl, diisopropyl, and other ethers**, including tetrahydrofuran and 1,4-dioxane and particularly the branched-chain type of ethers, sometimes explode during heating or refluxing because the presence of peroxides has developed from air oxidation. Ferrous salts or sodium bisulfite can be used to decompose these peroxides, and passage over basic active alumina can remove most of the peroxidic material. In general, however, old samples of ethers should be disposed of after testing, following procedures for disposal of peroxides.
- **Dimethyl sulfoxide** (DMSO), (CH_3)₂SO, decomposes violently on contact with a wide variety of active halogen compounds, such as acyl chlorides. Explosions from contact with active metal hydrides have been reported. Dimethyl sulfoxide does penetrate and carry dissolved substances through the skin membrane.
- **Dry benzoyl peroxide** ($C_6H_5CO_2$)₂ is easily ignited and sensitive to shock. It decomposes spontaneously at temperatures above 50 °C. It is reported to be desensitized by addition of 20% water.
- **Dry ice** should not be kept in a container that is not designed to withstand pressure. Containers of other substances stored over dry ice for extended periods generally absorb carbon dioxide (CO_2) unless they have been sealed with care. When such containers are removed from storage and allowed to come rapidly to room temperature, the CO_2 may develop sufficient pressure to burst the container with explosive violence.
- **Drying agents**, such as Ascarite® (sodium hydroxide-coated silica), should not be mixed with phosphorus pentoxide (P_2O_5) because the mixture may explode if it is warmed with a trace of water. Because the cobalt salts used as moisture indicators in some drying agents may be extracted by some organic solvents, the use of these drying agents should be restricted to drying gases.
- **Dusts** that are suspensions of oxidizable particles (e.g., magnesium powder, zinc dust, carbon powder, and flowers of sulfur) in the air can constitute powerful explosive mixtures. These materials should be used with adequate ventilation and should not be exposed to ignition sources. When finely divided, some solids, including zirconium, titanium, Raney nickel, lead (such as prepared by pyrolysis of lead tartrate), and catalysts (such as activated carbon containing active metals and hydrogen), can combust spontaneously if allowed to dry while exposed to air and should be handled wet.
- **Ethylene oxide** (C_2H_4O) has been known to explode when heated in a closed vessel. Experiments using ethylene oxide under pressure should be carried out behind suitable barricades.
- **Halogenated compounds**, such as chloroform ($CHCl_3$), carbon tetrachloride (CCl_4), and other halogenated solvents, should not be dried with sodium, potassium, or other active metal; violent explosions usually result. Many halogenated compounds are toxic. Oxidized halogen compounds—chlorates, chlorites, bromates, and iodates—and the corresponding peroxy compounds may be explosive at high temperatures.
- **Hydrogen peroxide** (H_2O_2) stronger than 3% can be dangerous; in contact with the skin, it can cause severe burns. Thirty percent H_2O_2 may decompose violently if contaminated with iron, copper, chromium, or other metals or their salts. Stirring bars may inadvertently bring metal into a reaction and should be used with caution.
- **Liquid nitrogen-cooled traps** open to the atmosphere condense liquid air rapidly. Then, when the coolant is removed, an explosive pressure buildup occurs, usually with enough force to shatter glass equipment if the system has been closed.
- **Lithium aluminum hydride** ($LiAlH_4$) should not be used to dry methyl ethers or tetrahydrofuran; fires from reaction with damp ethers are often observed. The reaction of $LiAlH_4$ with carbon dioxide has reportedly generated explosive products. Carbon dioxide or bicarbonate extinguishers should not be used for $LiAlH_4$ fires; instead such fires should be smothered with sand or some other inert substance.
- **Nitrates, nitro and nitroso compounds** may be explosive, especially if more than one nitro group is present. Alcohols and polyols can form highly explosive nitrate esters (e.g., nitroglycerine) from reaction with nitric acid.
- **Organometallics** are hazardous because some organometallic compounds burn vigorously on contact with air or moisture. For example, solutions of t-butyl lithium can cause ignition of some organic solvents on exposure to air.
- **Oxygen tanks** should be handled with care because serious explosions have resulted from contact between oil and high-pressure oxygen. Oil or grease should not be used on connections to an O_2 cylinder or gas line carrying O_2 .
- **Ozone** (O_3) is a highly reactive and toxic gas. It is formed by the action of ultraviolet light on oxygen (air), and, therefore, certain ultraviolet sources may require venting to the exhaust hood. Ozonides can be explosive.
- **Palladium (Pd) or platinum (Pt)** on carbon, platinum oxide, Raney nickel, and other catalysts present the danger of explosion if additional catalyst is added to a flask in which an air-flammable vapor mixture and/ or hydrogen is present. The use of flammable filter paper should be avoided.
- **Parr bombs** used for hydrogenations should be handled with care behind a shield, and the operator should wear goggles and a face shield.
- **Perchlorates** should be avoided insofar as possible. Perchlorate salts of organic, organometallic, and inorganic cations are potentially explosive and have been set off either by heating or by shock. Perchlorates should not be used as drying agents if there is a possibility of contact with organic compounds or of proximity to a dehydrating acid strong enough to concentrate the perchloric acid ($HClO_4$) (e.g., in a drying train that has a bubble counter containing sulfuric acid). Seventy percent $HClO_4$ can be boiled safely at approximately 200 °C, but contact of the boiling undiluted acid or the hot vapor with organic matter, or even easily oxidized inorganic matter, will lead to serious explosions. Oxidizable substances must never be allowed to contact $HClO_4$. This includes wooden benchtops or hood enclosures, which may become highly flammable after absorbing $HClO_4$ liquid or vapors. Beaker tongs, rather than rubber gloves, should be used when handling fuming $HClO_4$.
- **Permanganates** are explosive when treated with sulfuric acid. If both compounds are used in an absorption train, an empty trap should be between them.
- **Peroxides** (inorganic) : when mixed with combustibles, barium, sodium, and potassium peroxides form explosives that ignite easily.
- **Phosphorus** (P) (red and white) forms explosive mixtures with oxidizing agents. White phosphorus should be stored under water because it ignites spontaneously in air. The reaction of phosphorus with aqueous hydroxides gives phosphine, which may either ignite spontaneously or explode in air.
- **Phosphorus trichloride** (PCl_3) reacts with water to form phosphorous acid with HCl evolution; the phosphorous acid decomposes on heating to form phosphine, which may either ignite spontaneously or explode. Care should be taken in opening containers of PCl_3 , and samples that have been exposed to moisture should not be heated without adequate shielding to protect the operator.
- **Potassium** (K) is much more reactive than sodium; it ignites quickly on exposure to humid air and, therefore, should be handled under the surface of a hydrocarbon solvent such as mineral oil or toluene (see *Sodium*). Potassium can form explosive peroxides on contact with air. If this happens, the act of cutting a surface crust off the metal can cause a severe explosion.
- **Residues from vacuum distillations** have been known to explode when the still was vented suddenly to the air before the residue was cool. Such explosions can be avoided by venting the still pot with nitrogen, by cooling it before venting, or by restoring the pressure slowly. Sudden venting may produce a shockwave that can detonate sensitive materials.
- **Sodium** (Na) should be stored in a closed container under kerosene, toluene, or mineral oil. Scraps of sodium or potassium should be destroyed by reaction with n-butyl alcohol. Contact with water should be avoided because sodium reacts violently with water to form hydrogen (H_2) with evolution of sufficient heat to cause ignition. Carbon dioxide, bicarbonate, and carbon tetrachloride fire extinguishers should not be used on alkali metal fires. Metals like sodium become more reactive as the surface area of the particles increases. Prudence dictates using the largest particle size consistent with the task at hand. For example, use of sodium "balls" or cubes is preferable to use of sodium "sand" for drying solvents.
- **Sodium amide** ($NaNH_2$) can undergo oxidation on exposure to air to give sodium nitrite in a mixture that is unstable and may explode.
- **Sulfuric acid** (H_2SO_4) should be avoided, if possible, as a drying agent in desiccators. If it must be used, glass beads should be placed in it to help prevent splashing when the desiccator is moved. To dilute H_2SO_4 , the acid should be added slowly to cold water. Addition of water to the denser H_2SO_4 can cause localized surface boiling and spattering on the operator.
- **Trichloroethylene** (Cl_2CCHCl) reacts under a variety of conditions with potassium or sodium hydroxide to form dichloroacetylene, which ignites spontaneously in air and detonates readily even at dry ice temperatures. The compound itself is highly toxic, and suitable precautions should be taken when it is used.

1		12		⁴⁴ Ca	2.086%	⁶² Ni	3.63%	36		⁹⁸ Mo	24.13%	¹¹⁵ In	95.71%	¹³¹ Xe	21.18%	62		68		¹⁸³ W	14.31%	²⁰² Hg	29.9%
¹ H	99.9885%	²⁴ Mg	78.99%	⁴⁶ Ca	0.004%	⁶⁴ Ni	0.92%	⁷⁸ Kr	0.35%	44		50		¹³² Xe	26.89%	¹⁴⁴ Sm	3.07%	¹⁶² Er	0.14%	¹⁸⁴ W	30.64%	²⁰⁴ Hg	6.87%
² H	0.0115%	²⁵ Mg	10%	⁴⁸ Ca	0.187%	29		⁸⁰ Kr	2.28%	¹⁰⁰ Ru	12.6%	¹¹² Sn	0.97%	¹³⁴ Xe	10.44%	¹⁴⁷ Sm	15.0%	¹⁶⁴ Er	1.61%	¹⁸⁶ W	28.43%	81	
2		²⁶ Mg	11.01%	21		⁶³ Cu	69.17%	⁸² Kr	11.58%	¹⁰¹ Ru	17.06%	¹¹⁴ Sn	0.66%	¹³⁶ Xe	8.87%	¹⁴⁸ Sm	11.2%	¹⁶⁶ Er	33.61%	75		²⁰³ Tl	29.5%
³ He	0.000137%	13		⁴⁵ Sc	100%	⁶⁵ Cu	30.83%	⁸³ Kr	11.49%	¹⁰² Ru	31.55%	¹¹⁵ Sn	0.34%	55		¹⁴⁹ Sm	13.8%	¹⁶⁷ Er	22.93%	¹⁸⁵ Re	37.4%	²⁰⁵ Tl	70.5%
⁴ He	99.999863%	²⁷ Al	100%	22		30		⁸⁴ Kr	57%	¹⁰⁴ Ru	18.62%	¹¹⁶ Sn	14.54%	¹³³ Cs	100%	¹⁵⁰ Sm	7.38%	¹⁶⁸ Er	26.78%	¹⁸⁷ Re	62.6%	82	
3		14		⁴⁶ Ti	8.25%	⁶⁴ Zn	48.63%	⁸⁶ Kr	17.3%	⁹⁶ Ru	5.54%	¹¹⁷ Sn	7.68%	56		¹⁵² Sm	26.8%	¹⁷⁰ Er	14.93%	76		²⁰⁴ Pb	1.4%
⁶ Li	7.59%	²⁸ Si	92.23%	⁴⁷ Ti	7.44%	⁶⁶ Zn	27.9%	37		⁹⁸ Ru	1.87%	¹¹⁸ Sn	24.22%	¹³⁰ Ba	0.106%	¹⁵⁴ Sm	22.8%	69		¹⁸⁴ Os	0.02%	²⁰⁶ Pb	24.1%
⁷ Li	92.41%	²⁹ Si	4.68%	⁴⁸ Ti	73.72%	⁶⁷ Zn	4.1%	⁸⁵ Rb	72.17%	⁹⁹ Ru	12.76%	¹¹⁹ Sn	8.59%	¹³² Ba	0.101%	63		¹⁶⁹ Tm	100%	¹⁸⁶ Os	1.59%	²⁰⁷ Pb	22.1%
4		³⁰ Si	3.09%	⁴⁹ Ti	5.41%	⁶⁸ Zn	18.75%	⁸⁷ Rb	27.83%	45		¹²⁰ Sn	32.58%	¹³⁴ Ba	2.42%	¹⁵¹ Eu	47.8%	70		¹⁸⁷ Os	1.96%	²⁰⁸ Pb	52.4%
⁹ Be	100%	15		⁵⁰ Ti	5.18%	⁷⁰ Zn	0.62%	38		¹⁰³ Rh	100%	¹²² Sn	4.63%	¹³⁵ Ba	6.59%	¹⁵³ Eu	52.2%	¹⁶⁸ Yb	0.13%	¹⁸⁸ Os	13.24%	83	
5		³¹ P	100%	23		31		⁸⁴ Sr	0.56%	46		¹²⁴ Sn	5.79%	¹³⁶ Ba	7.85%	64		¹⁷⁰ Yb	3.04%	¹⁸⁹ Os	16.15%	²⁰⁹ Bi	100%
¹⁰ B	19.9%	16		⁵⁰ V	0.25%	⁶⁹ Ga	60.11%	⁸⁶ Sr	9.86%	¹⁰² Pd	1.02%	51		¹³⁷ Ba	11.23%	¹⁵² Gd	0.2%	¹⁷¹ Yb	14.28%	¹⁹⁰ Os	26.26%	90	
¹¹ B	80.1%	³² S	94.93%	⁵¹ V	99.75%	⁷¹ Ga	39.89%	⁸⁷ Sr	7%	¹⁰⁴ Pd	11.14%	¹²¹ Sb	57.21%	¹³⁸ Ba	71.70%	¹⁵⁴ Gd	2.18%	¹⁷² Yb	21.83%	¹⁹² Os	40.78%	²³² Th	100%
6		³³ S	0.76%	24		32		⁸⁸ Sr	82.58%	¹⁰⁵ Pd	22.33%	¹²³ Sb	42.79%	57		¹⁵⁵ Gd	14.8%	¹⁷³ Yb	16.13%	77		92	
¹² C	98.93%	³⁴ S	4.29%	⁵⁰ Cr	4.345%	⁷⁰ Ge	20.84%	39		¹⁰⁶ Pd	27.33%	52		¹³⁸ La	0.09%	¹⁵⁶ Gd	20.5%	¹⁷⁴ Yb	31.83%	¹⁹¹ Ir	37.3%	²³⁸ U	99.3%
¹³ C	1.07%	³⁶ S	0.02%	⁵² Cr	83.789%	⁷² Ge	27.54%	⁸⁹ Y	100%	¹⁰⁸ Pd	26.46%	¹²⁰ Te	0.09%	¹³⁹ La	99.91%	¹⁵⁷ Gd	15.7%	¹⁷⁶ Yb	12.76%	¹⁹³ Ir	62.7%		
7		17		⁵³ Cr	9.501%	⁷³ Ge	7.73%	40		¹¹⁰ Pd	11.72%	¹²² Te	2.55%	58		¹⁵⁸ Gd	24.8%	71		78			
¹⁴ N	99.632%	³⁵ Cl	75.78%	⁵⁴ Cr	2.365%	⁷⁴ Ge	36.28%	⁹⁰ Zr	51.45%	47		¹²³ Te	0.89%	¹³⁶ Ce	0.185%	¹⁶⁰ Gd	21.9%	¹⁷⁵ Lu	97.41%	¹⁹⁰ Pt	0.014%		
¹⁵ N	0.368%	³⁷ Cl	24.22%	25		⁷⁶ Ge	7.61%	⁹¹ Zr	11.22%	¹⁰⁷ Ag	51.84%	¹²⁴ Te	4.74%	¹³⁸ Ce	0.251%	65		¹⁷⁶ Lu	2.59%	¹⁹² Pt	0.782%		
8		18		⁵⁵ Mn	100%	33		⁹² Zr	17.15%	¹⁰⁹ Ag	48.16%	¹²⁵ Te	7.07%	¹⁴⁰ Ce	88.45%	¹⁵⁹ Tb	100%	72		¹⁹⁴ Pt	32.97%		
¹⁶ O	99.757%	³⁶ Ar	0.337%	26		⁷⁵ As	100%	⁹⁴ Zr	17.38%	48		¹²⁶ Te	18.84%	¹⁴² Ce	11.11%	66		¹⁷⁴ Hf	0.16%	¹⁹⁵ Pt	33.83%		
¹⁷ O	0.038%	³⁸ Ar	0.063%	⁵⁴ Fe	5.845%	34		⁹⁶ Zr	2.8%	¹⁰⁶ Cd	1.25%	¹²⁸ Te	31.74%	59		¹⁵⁶ Dy	0.06%	¹⁷⁶ Hf	5.26%	¹⁹⁶ Pt	25.24%		
¹⁸ O	0.205%	⁴⁰ Ar	99.60%	⁵⁶ Fe	91.754%	⁷⁴ Se	0.89%	41		¹⁰⁸ Cd	0.89%	¹³⁰ Te	34.08%	¹⁴¹ Pr	100%	¹⁵⁸ Dy	0.1%	¹⁷⁷ Hf	18.6%	¹⁹⁸ Pt	7.16%		
9		19		⁵⁷ Fe	2.119%	⁷⁶ Se	9.37%	⁹³ Nb	100%	¹¹⁰ Cd	12.49%	53		60		¹⁶⁰ Dy	2.34%	¹⁷⁸ Hf	27.28%	79			
¹⁹ F	100%	³⁹ K	93.26%	⁵⁸ Fe	0.282%	⁷⁷ Se	7.63%	42		¹¹¹ Cd	12.8%	¹²⁷ I	100%	¹⁴² Nd	27.2%	¹⁶¹ Dy	18.9%	¹⁷⁹ Hf	13.62%	¹⁹⁷ Au	100%		
10		⁴⁰ K	0.012%	27		⁷⁸ Se	23.77%	¹⁰⁰ Mo	9.63%	¹¹² Cd	24.13%	54		¹⁴³ Nd	12.2%	¹⁶² Dy	25.5%	¹⁸⁰ Hf	35.08%	80			
²⁰ Ne	90.48%	⁴¹ K	6.73%	⁵⁹ Co	100%	⁸⁰ Se	49.61%	⁹² Mo	14.84%	¹¹³ Cd	12.22%	¹²⁴ Xe	0.09%	¹⁴⁴ Nd	23.8%	¹⁶³ Dy	24.9%	73		¹⁹⁶ Hg	0.15%		
²¹ Ne	0.27%	20		28		⁸² Se	8.73%	⁹⁴ Mo	9.25%	¹¹⁴ Cd	28.73%	¹²⁶ Xe	0.09%	¹⁴⁵ Nd	8.3%	¹⁶⁴ Dy	28.2%	¹⁸¹ Ta	99.99%	¹⁹⁸ Hg	9.97%		
²² Ne	9.25%	⁴⁰ Ca	96.9%	⁵⁸ Ni	68.077%	35		⁹⁵ Mo	15.92%	¹¹⁶ Cd	7.49%	¹²⁸ Xe	1.92%	¹⁴⁶ Nd	17.2%	67		74		¹⁹⁹ Hg	16.87%		
11		⁴² Ca	0.647%	⁶⁰ Ni	26.223%	⁷⁹ Br	50.69%	⁹⁶ Mo	16.68%	49		¹²⁹ Xe	26.44%	¹⁴⁸ Nd	5.7%	¹⁶⁵ Ho	100%	¹⁸⁰ W	0.12%	²⁰⁰ Hg	23.1%		
²³ Na	100%	⁴³ Ca	0.135%	⁶¹ Ni	1.140%	⁸¹ Br	49.31%	⁹⁷ Mo	9.55%	¹¹³ In	4.29%	¹³⁰ Xe	4.08%	¹⁵⁰ Nd	5.6%			¹⁸² W	26.5%	²⁰¹ Hg	13.18%		