

Table of Contents

Introduction.....	1
References.....	14
Encyclopedias	16
Recent or large general texts	16
On various large groups of elements.....	17
On broad topics	18
Other articles cited in the text	23
 1 Hydrogen and the Alkali Metals.....	 25
1.0 Hydrogen, ${}_1\text{H}$	25
1.0.1 Reagents Derived from Hydrogen and Oxygen.....	25
1.0.2 Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	26
1.0.3 Reagents Derived from the 3 rd -to-5 th -Period Non-Metals, Silicon through Xenon.....	27
1.0.4 Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	27
1.1 Lithium, ${}_3\text{Li}$	28
1.1.1 Reagents Derived from Hydrogen and Oxygen.....	28
1.1.2 Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	29
1.1.3 Reagents Derived from the 3 rd -to-5 th -Period Non-Metals, Silicon through Xenon.....	29
1.1.4 Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	29
1.2 Sodium, ${}_{11}\text{Na}$	30
1.2.1 Reagents Derived from Hydrogen and Oxygen.....	30
1.2.2 Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	30
1.2.3 Reagents Derived from the 3 rd -to-5 th -Period Non-Metals, Silicon through Xenon.....	31
1.2.4 Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	31

1.3	Potassium, $_{19}\text{K}$; Rubidium, $_{37}\text{Rb}$; Cesium, $_{55}\text{Cs}$ and Francium, $_{87}\text{Fr}$	31
1.3.1	Reagents Derived from Hydrogen and Oxygen.....	31
1.3.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	33
1.3.3	Reagents Derived from the 3 rd -to-5 th -Period Non-Metals, Silicon through Xenon.....	33
1.3.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	34
	References.....	35
	Bibliography	35
2	Beryllium and the Alkaline-Earth Metals	37
2.1	Beryllium, $_{4}\text{Be}$	37
2.1.1	Reagents Derived from Hydrogen and Oxygen.....	37
2.1.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	37
2.1.3	Reagents Derived from the 3 rd -to-5 th -Period Non-Metals, Silicon through Xenon.....	38
2.2	Magnesium, $_{12}\text{Mg}$	39
2.2.1	Reagents Derived from Hydrogen and Oxygen.....	39
2.2.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	39
2.2.3	Reagents Derived from the 3 rd -to-5 th -Period Non-Metals, Silicon through Xenon.....	40
2.2.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	41
2.3	Calcium, $_{20}\text{Ca}$; Strontium, $_{38}\text{Sr}$; Barium, $_{56}\text{Ba}$ and Radium, $_{88}\text{Ra}$	41
2.3.1	Reagents Derived from Hydrogen and Oxygen.....	41
2.3.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	43
2.3.3	Reagents Derived from the 3 rd -to-5 th -Period Non-Metals, Silicon through Xenon.....	44
2.3.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	46
	Bibliography	47
3	The Rare-Earth and Actinoid Elements	49
3.1	The Rare Earths Rth(0) and Actinoids An(0)	52
3.1.1	Reagents Derived from Hydrogen and Oxygen.....	52
3.1.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	53

3.1.3	Reagents Derived from the 3 rd -to-5 th -Period Non-Metals, Silicon through Xenon.....	54
3.1.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	54
3.2	The Rare Earths Rth(II) and Actinoids An(II)	54
3.2.1	Reagents Derived from Hydrogen and Oxygen.....	54
3.2.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	55
3.2.3	Reagents Derived from the 3 rd -to-5 th -Period Non-Metals, Silicon through Xenon.....	55
3.2.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	55
3.3	The Rare Earths Rth(III) and Actinoids An(III).....	56
3.3.1	Reagents Derived from Hydrogen and Oxygen.....	56
3.3.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	58
3.3.3	Reagents Derived from the 3 rd -to-5 th -Period Non-Metals, Silicon through Xenon.....	61
3.3.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	63
3.4	The Lanthanoids Ln(IV) and Actinoids An(IV).....	65
3.4.1	Reagents Derived from Hydrogen and Oxygen.....	65
3.4.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	67
3.4.3	Reagents Derived from the 3 rd -to-5 th -Period Non-Metals, Silicon through Xenon.....	71
3.4.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	73
3.5	The Actinoids An(V)	75
3.5.1	Reagents Derived from Hydrogen and Oxygen.....	75
3.5.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	76
3.5.3	Reagents Derived from the 3 rd -to-5 th -Period Non-Metals, Silicon through Xenon.....	78
3.5.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	79
3.6	The Actinoids An(VI)	79
3.6.1	Reagents Derived from Hydrogen and Oxygen.....	79
3.6.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	81
3.6.3	Reagents Derived from the 3 rd -to-5 th -Period Non-Metals, Silicon through Xenon.....	83
3.6.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	85

3.7	The Actinoids An(VII).....	86
3.7.1	Reagents Derived from Hydrogen and Oxygen.....	86
3.7.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	87
3.7.3	Reagents Derived from the Heavier Non-Metals, Silicon through Xenon.....	87
3.7.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	87
	References.....	87
	Bibliography	87
4	Titanium through Rutherfordium.....	91
4.1	Titanium, ²² Ti	91
4.1.1	Reagents Derived from Hydrogen and Oxygen.....	91
4.1.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	92
4.1.3	Reagents Derived from the 3 rd -to-5 th -Period Non-Metals, Silicon through Xenon.....	93
4.1.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	94
4.2	Zirconium, ⁴⁰ Zr; Hafnium, ⁷² Hf; and Rutherfordium, ¹⁰⁴ Rf	95
4.2.1	Reagents Derived from Hydrogen and Oxygen.....	95
4.2.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	96
4.2.3	Reagents Derived from the 3 rd -to-5 th -Period Non-Metals, Silicon through Xenon.....	98
4.2.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	99
	Bibliography	99
5	Vanadium through Dubnium.....	101
5.1	Vanadium, ²³ V	101
5.1.1	Reagents Derived from Hydrogen and Oxygen.....	101
5.1.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	103
5.1.3	Reagents Derived from the 3 rd -to-5 th -Period Non-Metals, Silicon through Xenon.....	105
5.1.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	106
5.2	Niobium, ⁴¹ Nb; Tantalum, ⁷³ Ta; and Dubnium, ¹⁰⁵ Db	108
5.2.1	Reagents Derived from Hydrogen and Oxygen.....	108
5.2.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	109

5.2.3	Reagents Derived from the 3 rd -to-5 th -Period Non-Metals, Silicon through Xenon	110
5.2.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	111
	Bibliography	111
6	Chromium through Seaborgium	113
6.1	Chromium, ²⁴ Cr	113
6.1.1	Reagents Derived from Hydrogen and Oxygen	113
6.1.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	117
6.1.3	Reagents Derived from the 3 rd -to-5 th -Period Non-Metals, Silicon through Xenon	121
6.1.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	124
6.2	Molybdenum, ⁴² Mo; Tungsten, ⁷⁴ W and Seaborgium, ¹⁰⁶ Sg	126
6.2.1	Reagents Derived from Hydrogen and Oxygen	127
6.2.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	130
6.2.3	Reagents Derived from the 3 rd -to-5 th -Period Non-Metals, Silicon through Xenon	134
6.2.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	140
6.2.5	Reactions Involving Chalcogeno Mo and W Clusters	144
	References	151
	Bibliography	151
7	Manganese through Bohrium	153
7.1	Manganese, ²⁵ Mn	153
7.1.1	Reagents Derived from Hydrogen and Oxygen	153
7.1.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	155
7.1.3	Reagents Derived from the 3 rd -to-5 th -Period Non-Metals, Silicon through Xenon	157
7.1.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	161
7.2	Technetium, ⁴³ Tc; Rhenium, ⁷⁵ Re and Bohrium, ¹⁰⁷ Bh	163
7.2.1	Reagents Derived from Hydrogen and Oxygen	163
7.2.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	165
7.2.3	Reagents Derived from the 3 rd -to-5 th -Period Non-Metals, Silicon through Xenon	167
7.2.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	169
	Bibliography	171

8	Iron through Hassium	173
8.1	Iron, ^{26}Fe	173
8.1.1	Reagents Derived from Hydrogen and Oxygen.....	173
8.1.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	178
8.1.3	Reagents Derived from the 3 rd -to-5 th -Period Non-Metals, Silicon through Xenon.....	183
8.1.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	187
8.1.5	Reactions Involving the Prussian Blues	190
8.2	Ruthenium, ^{44}Ru ; Osmium, ^{76}Os and Hassium, ^{108}Hs	192
8.2.1	Reagents Derived from Hydrogen and Oxygen.....	193
8.2.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	196
8.2.3	Reagents Derived from the 3 rd -to-5 th -Period Non-Metals, Silicon through Xenon.....	202
8.2.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	205
	References.....	209
	Bibliography	209
9	Cobalt through Meitnerium.....	211
9.1	Cobalt, ^{27}Co	211
9.1.1	Reagents Derived from Hydrogen and Oxygen.....	211
9.1.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	216
9.1.3	Reagents Derived from the 3 rd -to-5 th -Period Non-Metals, Silicon through Xenon.....	222
9.1.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	226
9.2	Rhodium, ^{45}Rh ; Iridium, ^{77}Ir and Meitnerium, ^{109}Mt	230
9.2.1	Reagents Derived from Hydrogen and Oxygen.....	230
9.2.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	231
9.2.3	Reagents Derived from the 3 rd -to-5 th -Period Non-Metals, Silicon through Xenon.....	235
9.2.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	238
	Reference	240
	Bibliography	240
10	Nickel through Darmstadtium.....	241
10.1	Nickel, ^{28}Ni	241
10.1.1	Reagents Derived from Hydrogen and Oxygen.....	241

10.1.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	242
10.1.3	Reagents Derived from the 3 rd -to-5 th -Period Non-Metals, Silicon through Xenon	244
10.1.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	246
10.2	Palladium, ⁴⁶ Pd; Platinum, ⁷⁸ Pt and Darmstadtium, ¹¹⁰ Ds.....	247
10.2.1	Reagents Derived from Hydrogen and Oxygen	247
10.2.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	250
10.2.3	Reagents Derived from the 3 rd -to-5 th -Period Non-Metals, Silicon through Xenon	254
10.2.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	259
	References	261
	Bibliography	261
11	Copper through Roentgenium	263
11.1	Copper, ²⁹ Cu.....	263
11.1.1	Reagents Derived from Hydrogen and Oxygen	263
11.1.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	264
11.1.3	Reagents Derived from the 3 rd -to-5 th -Period Non-Metals, Silicon through Xenon	267
11.1.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	269
11.2	Silver, ⁴⁷ Ag.....	271
11.2.1	Reagents Derived from Hydrogen and Oxygen.....	271
11.2.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	272
11.2.3	Reagents Derived from the 3 rd -to-5 th -Period Non-Metals, Silicon through Xenon.....	274
11.2.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	279
11.3	Gold, ⁷⁹ Au and Roentgenium, ¹¹¹ Rg	281
11.3.1	Reagents Derived from Hydrogen and Oxygen.....	281
11.3.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	282
11.3.3	Reagents Derived from the 3 rd -to-5 th -Period Non-Metals, Silicon through Xenon.....	283
11.3.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	286
	Reference	287
	Bibliography	287

12 Zinc through Mercury.....	289
12.1 Zinc, $_{30}\text{Zn}$	289
12.1.1 Reagents Derived from Hydrogen and Oxygen.....	289
12.1.2 Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	290
12.1.3 Reagents Derived from the 3rd-to-5th-Period Non-Metals, Silicon through Xenon.....	291
12.1.4 Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	292
12.2 Cadmium, $_{48}\text{Cd}$	292
12.2.1 Reagents Derived from Hydrogen and Oxygen.....	292
12.2.2 Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	293
12.2.3 Reagents Derived from the 3rd-to-5th-Period Non-Metals, Silicon through Xenon.....	294
12.2.4 Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	295
12.3 Mercury, $_{80}\text{Hg}$ (and Ununbium, $_{112}\text{Uub}$).....	295
12.3.1 Reagents Derived from Hydrogen and Oxygen.....	295
12.3.2 Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	297
12.3.3 Reagents Derived from the 3rd-to-5th-Period Non-Metals, Silicon through Xenon.....	299
12.3.4 Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	304
Reference	306
Bibliography	306
 13 Boron through Thallium, the Triels.....	 307
13.1 Boron, $_{5}\text{B}$	307
13.1.1 Reagents Derived from Hydrogen and Oxygen.....	307
13.1.2 Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	308
13.1.3 Reagents Derived from the 3rd-to-5th-Period Non-Metals, Silicon through Xenon.....	309
13.1.4 Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	310
13.2 Aluminum, $_{13}\text{Al}$	310
13.2.1 Reagents Derived from Hydrogen and Oxygen.....	310
13.2.2 Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	311
13.2.3 Reagents Derived from the 3rd-to-5th-Period Non-Metals, Silicon through Xenon.....	313
13.2.4 Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	314

13.3	Gallium, $_{31}\text{Ga}$	314
13.3.1	Reagents Derived from Hydrogen and Oxygen	314
13.3.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	315
13.3.3	Reagents Derived from the 3rd-to-5th-Period Non-Metals, Silicon through Xenon	316
13.3.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	317
13.4	Indium, $_{49}\text{In}$	317
13.4.1	Reagents Derived from Hydrogen and Oxygen	317
13.4.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	318
13.4.3	Reagents Derived from the Heavier Non-Metals, Silicon through Xenon	318
13.4.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	319
13.5	Thallium, $_{81}\text{Tl}$ (and Ununtrium, $_{113}\text{Uut}$)	320
13.5.1	Reagents Derived from Hydrogen and Oxygen	320
13.5.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	321
13.5.3	Reagents Derived from the 3rd-to-5th-Period Non-Metals, Silicon through Xenon	322
13.5.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	324
	Reference	325
	Bibliography	325
14	Carbon through Lead, the Tetrels	327
14.1	Carbon, $_{6}\text{C}$	327
14.1.1	Reagents Derived from Hydrogen and Oxygen	327
14.1.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	331
14.1.3	Reagents Derived from the 3rd-to-5th-Period Non-Metals, Silicon through Xenon	332
14.1.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	334
14.2	Silicon, $_{14}\text{Si}$	340
14.2.1	Reagents Derived from Hydrogen and Oxygen	340
14.2.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	341
14.2.3	Reagents Derived from the 3rd-to-5th-Period Non-Metals, Silicon through Xenon	341
14.2.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	342

14.3	Germanium, ^{32}Ge	342
14.3.1	Reagents Derived from Hydrogen and Oxygen.....	342
14.3.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	343
14.3.3	Reagents Derived from the 3rd-to-5th-Period Non-Metals, Silicon through Xenon.....	343
14.3.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	345
14.4	Tin, ^{50}Sn	345
14.4.1	Reagents Derived from Hydrogen and Oxygen.....	346
14.4.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	348
14.4.3	Reagents Derived from the 3rd-to-5th-Period Non-Metals, Silicon through Xenon.....	349
14.4.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	353
14.5	Lead, ^{82}Pb (and Ununquadium, ^{114}Uuq).....	354
14.5.1	Reagents Derived from Hydrogen and Oxygen.....	354
14.5.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	356
14.5.3	Reagents Derived from the 3rd-to-5th-Period Non-Metals, Silicon through Xenon.....	357
14.5.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	360
	References.....	362
	Bibliography	362
15	Nitrogen through Bismuth, the Pentels.....	363
15.1	Nitrogen, ^{7}N	363
15.1.1	Reagents Derived from Hydrogen and Oxygen.....	363
15.1.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	365
15.1.3	Reagents Derived from the 3rd-to-5th-Period Non-Metals, Silicon through Xenon.....	366
15.1.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	369
15.2	Phosphorus, ^{15}P	374
15.2.1	Reagents Derived from Hydrogen and Oxygen.....	375
15.2.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	378
15.2.3	Reagents Derived from the 3rd-to-5th-Period Non-Metals, Silicon through Xenon.....	379
15.2.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	381

15.3	Arsenic, $_{33}\text{As}$	385
15.3.1	Reagents Derived from Hydrogen and Oxygen	385
15.3.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	386
15.3.3	Reagents Derived from the 3rd-to-5th-Period Non-Metals, Silicon through Xenon	387
15.3.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	390
15.4	Antimony, $_{51}\text{Sb}$	393
15.4.1	Reagents Derived from Hydrogen and Oxygen	393
15.4.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	395
15.4.3	Reagents Derived from the 3rd-to-5th-Period Non-Metals, Silicon through Xenon	397
15.4.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	400
15.5	Bismuth, $_{83}\text{Bi}$ (and Ununpentium, $_{115}\text{Uup}$)	401
15.5.1	Reagents Derived from Hydrogen and Oxygen	401
15.5.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	402
15.5.3	Reagents Derived from the 3rd-to-5th-Period Non-Metals, Silicon through Xenon	403
15.5.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	405
	Bibliography	406
16	Oxygen through Polonium, the Chalcogens	409
16.1	Oxygen, $_{8}\text{O}$	409
16.1.1	Reagents Derived from Hydrogen and Oxygen	409
16.1.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	410
16.1.3	Reagents Derived from the 3rd-to-5th-Period Non-Metals, Silicon through Xenon	410
16.1.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	411
16.2	Sulfur, $_{16}\text{S}$	415
16.2.1	Reagents Derived from Hydrogen and Oxygen	415
16.2.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	420
16.2.3	Reagents Derived from the 3rd-to-5th-Period Non-Metals, Silicon through Xenon	422
16.2.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	426

16.3	Selenium, ^{34}Se	436
16.3.1	Reagents Derived from Hydrogen and Oxygen.....	436
16.3.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	436
16.3.3	Reagents Derived from the 3rd-to-5th-Period Non-Metals, Silicon through Xenon.....	437
16.3.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	438
16.4	Tellurium, ^{52}Te and Polonium, ^{84}Po (and Ununhexium, ^{116}Uuh).....	439
16.4.1	Reagents Derived from Hydrogen and Oxygen.....	439
16.4.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	440
16.4.3	Reagents Derived from the 3rd-to-5th-Period Non-Metals, Silicon through Xenon.....	440
16.4.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	441
	Bibliography	442
17	Fluorine through Astatine, the Halogens	445
17.1	Fluorine, ^9F	445
17.1.1	Reagents Derived from Hydrogen and Oxygen.....	445
17.1.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	445
17.1.3	Reagents Derived from the 3rd-to-5th-Period Non-Metals, Silicon through Xenon.....	446
17.1.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	446
17.2	Chlorine, ^{17}Cl	447
17.2.1	Reagents Derived from Hydrogen and Oxygen.....	447
17.2.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	449
17.2.3	Reagents Derived from the 3rd-to-5th-Period Non-Metals, Silicon through Xenon.....	451
17.2.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	454
17.3	Bromine, ^{35}Br	459
17.3.1	Reagents Derived from Hydrogen and Oxygen.....	459
17.3.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	460
17.3.3	Reagents Derived from the 3rd-to-5th-Period Non-Metals, Silicon through Xenon.....	461
17.3.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	462

17.4	Iodine, $_{53}\text{I}$ and Astatine, $_{85}\text{At}$ (and Ununseptium, $_{117}\text{Uus}$)	464
17.4.1	Reagents Derived from Hydrogen and Oxygen	465
17.4.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	466
17.4.3	Reagents Derived from the 3 rd -to-5 th -Period Non-Metals, Silicon through Xenon	467
17.4.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	471
Reference		474
Bibliography		474
18	Helium through Radon, the Aerogens.....	475
18.0	Helium, $_{2}\text{He}$ through 18.2 Argon, $_{18}\text{Ar}$	475
18.3	Krypton, $_{36}\text{Kr}$	475
18.4	Xenon, $_{54}\text{Xe}$ and Radon, $_{86}\text{Rn}$ (and Ununoctium, $_{118}\text{Uuo}$)	475
18.4.1	Reagents Derived from Hydrogen and Oxygen	475
18.4.2	Reagents Derived from the Other 2 nd -Period Non-Metals, Boron through Fluorine	476
18.4.3	Reagents Derived from the 3 rd -to-5 th -Period Non-Metals, Silicon through Xenon	476
18.4.4	Reagents Derived from the Metals Lithium through Uranium, plus Electrons and Photons	477
Reference		477
Bibliography		477
Appendix A:	Periodic Charts.....	479
References.....		490
Appendix B:	Atomic and Ionic Energy Levels	491
References.....		494
Appendix C:	Electrode/Reduction Potentials	495
References.....		512
Appendix D:	Abbreviations and Definitions.....	513
Index.....		515