Appendix A Reference Tables

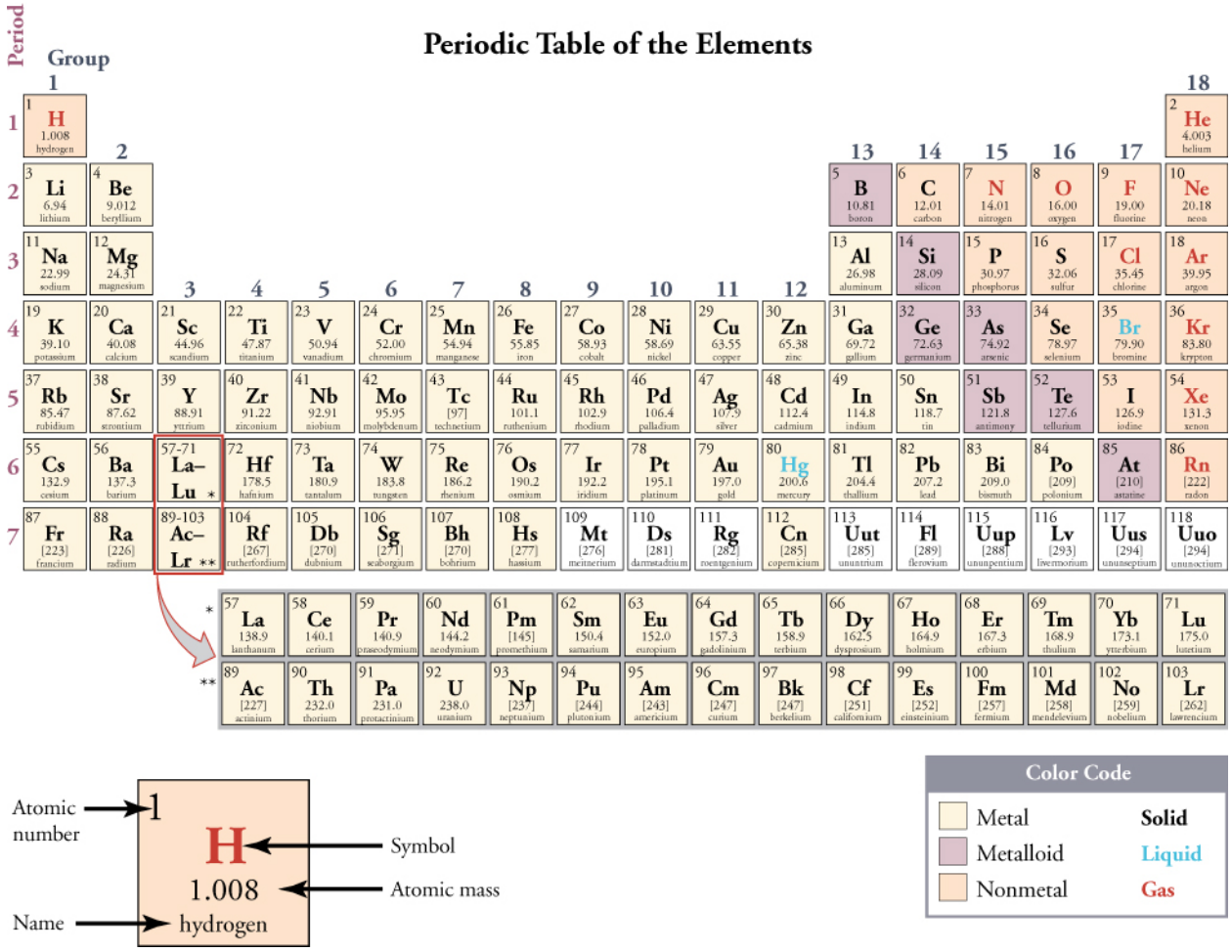

Figure A1 Periodic Table of Elements

Table A1 Metric Prefixes for Powers of Ten and Their Symbols

Table A2 SI Units

Table A3 Selected British Units

Table A4 Other Units

Table A5 Useful formulae

Symbol	Meaning	Best Value	Approximate Value
c	Speed of light in vacuum	2.99792458×10^8m/s	3.00×10^8m/s
G	Gravitational constant	$6.67384(80) \times 10^{-11}\mathrm{N} \cdot \mathrm{m}^2/\mathrm{kg}^2$	$6.67 \times 10^{-11}\mathrm{N} \cdot \mathrm{m}^2/\mathrm{kg}^2$
${}^N A$	Avogadro's number	$6.02214129(27) \times 10^{23}$J/K	6.02×10^{23}
k	Boltzmann's constant	$1.3806488(13) \times 10^{-23}$J/K	1.38×10^{-23}J/K
R	Gas constant	8.3144621(75) J/mol K	$8.31\ J/\mathrm{mol} \cdot \mathrm{K} = 1.99\ cal/\mathrm{mol} \cdot \mathrm{K} = 0.0821\ atm \cdot \mathrm{L/mol} \cdot \mathrm{K}$
	Stefan-Boltzmann Constant	$5.670373(21) \times 10^{-8}\mathrm{W/m}^2 \cdot \mathrm{K}$	$5.67 \times 10^{-8}\mathrm{W/m}^2 \cdot \mathrm{K}$

Symbol	Meaning	Best Value	Approximate Value
k	Coulomb force constant	$8.987551788... \times 10^{9}\mathrm{N} \cdot \mathrm{m}^{2}/\mathrm{C}^{2}$	$8.99 \times 10^{9}\mathrm{N} \cdot \mathrm{m}^{2}/\mathrm{C}^{2}$
^{q}e	Charge on electron	$-1.602176565(35) \times 10^{-19}\mathrm{C}$	$-1.60 \times 10^{-19}\mathrm{C}$
0	Permittivity of free space	$8.854187817... \times 10^{-12}\mathrm{C}^{2}/\mathrm{N} \cdot \mathrm{m}^{2}$	$8.85 \times 10^{-12}\mathrm{C}^{2}/\mathrm{N} \cdot \mathrm{m}^{2}$
$^{\mu}0$	Permeability of free space	$4\pi \times 10^{-7}\mathrm{T} \cdot \mathrm{m}/\mathrm{A}$	$1.26 \times 10^{-6}\mathrm{T} \cdot \mathrm{m}/\mathrm{A}$
h	Planck's constant	$6.62606957(29) \times 10^{-34}\mathrm{J} \cdot \mathrm{s}$	$6.63 \times 10^{-34}\mathrm{J} \cdot \mathrm{s}$

Table A6 Important Constants

Table A7 The Greek Alphabet

Table A8 Solar System Data

Atomic number, Z

Name

Atomic Mass Number, A

Symbol

Atomic Mass (u)

Percent Abundance or Decay Mode

Half-life, $^{t}1/2$

0

neutron

1

n

1.008 665

–

10.37 min

1

Hydrogen

1

^{1}H

1.007 825

99.985%

Deuterium

2

^{2}H or D

2.014 102

0.015%

Tritium

3

^{3}H or T

3.016 050

–

12.33 y

2

Helium

3

^{3}He

3.016 030

1.38×10^{-4} %

4

^{4}He

4.002 603

100%

3

Lithium

6

^{6}Li

6.015 121

7.5%

7

^{7}Li

7.016 003

92.5%

4

Beryllium

7

^{7}Be

7.016 928

EC

53.29 d

9

^{9}Be

9.012 182

100%

5

Boron

10

^{10}B

10.012 937

19.9%

11

^{11}B

11.009 305

80.1%

6

Carbon

11

^{11}C

11.011 432

EC, $^{+}$

12

^{12}C

12.000 000

98.90%

13

^{13}C

13.003 355

1.10%

14

^{14}C

14.003 241

$^{-}$

5730 y

7

Nitrogen

13

^{12}N

13.005 738

$^{+}$

9.96 min

14

^{13}N

14.003 074

99.63%

15

^{14}N

15.000 108

0.37%

8

Oxygen

15

^{15}O

15.003 065

EC, $^{+}$

122 s

16

^{16}O

15.994 915

99.76%

18

^{18}O

17.999 160

0.200%

9

Fluorine

18

^{18}F

18.000 937

EC, $^{+}$

1.83 h

19

^{19}F

18.998 403

100%

10

Neon

20

^{20}Ne

19.992 435

90.51%

22

^{22}Ne

21.991 383

9.22%

11

Sodium

22

^{22}Na

21.994 434

+

2.602 y

23

^{23}Na

22.989 767

100%

24

^{24}Na

23.990 961

−

14.96 h

12

Magnesium

24

^{24}Mg

23.985 042

78.99%

13

Aluminum

27

^{27}Al

26.981 539

100%

14

Silicon

28

^{28}Si

27.976 927

92.23%

2.62h

31

^{31}Si

30.975 362

–

15

Phosphorus

31

^{31}P

30.973 762

100%

32

^{32}P

31.973 907

–

14.28 d

16

Sulfur

32

^{32}S

31.972 070

95.02%

35

^{35}S

34.969 031

–

87.4 d

17

Chlorine

35

^{35}Cl

34.968 852

75.77%

37

^{37}Cl

36.965 903

24.23%

18

Argon

40

^{40}Ar

39.962 384

99.60%

19

Potassium

39

^{39}K

38.963 707

93.26%

40

^{40}K

39.963 999

0.0117%, EC, $^{-}$

1.28×10^{9} y

20

Calcium

40

^{40}Ca

39.962 591

96.94%

21

Scandium

45

^{45}Sc

44.955 910

100%

22

Titanium

48

^{48}Ti

47.947 947

73.8%

23

Vanadium

51

^{51}V

50.943 962

99.75%

24

Chromium

52

^{52}Cr

51.940 509

83.79%

25

Manganese

55

^{55}Mn

54.938 047

100%

26

Iron

56

^{56}Fe

55.934 939

91.72%

27

Cobalt

59

^{59}Co

58.933 198

100%

60

^{60}Co

59.933 819

–

5.271 y

28

Nickel

58

^{58}Ni

57.935 346

68.27%

60

^{60}Ni

59.930 788

26.10%

29

Copper

63

^{63}Cu

62.939 598

69.17%

^{65}Cu

64.927 793

30.83%

30

Zinc

64

^{64}Zn

63.929 145

48.6%

66

^{66}Zn

65.926 034

27.9%

31

Gallium

69

^{69}Ga

68.925 580

60.1%

32

Germanium

72

^{72}Ge

71.922 079

27.4%

74

^{74}Ge

73.921 177

36.5%

33

Arsenic

75

^{75}As

74.921 594

100%

34

Selenium

80

^{80}Se

79.916 520

49.7%

35

Bromine

79

^{79}Br

78.918 336

50.69%

36

Krypton

84

^{84}Kr

83.911 507

57.0%

37

Rubidium

85

^{85}Rb

84.911 794

72.17%

38

Strontium

86

^{86}Sr

85.909 267

9.86%

88

^{88}Sr

87.905 619

82.58%

90

^{90}Sr

89.907 738

–

28.8 y

39

Yttrium

89

^{89}Y

88.905 849

100%

90

^{90}Y

89.907 152

–

64.1 h

40

Zirconium

90

^{90}Zr

89.904 703

51.45%

41

Niobium

93

^{93}Nb

92.906 377

100%

42

Molybdenum

98

^{98}Mo

97.905 406

24.13%

43

Technetium

98

^{98}Tc

97.907 215

–

4.2×10^6 y

44

Ruthenium

102

^{102}Ru

101.904 348

31.6%

45

Rhodium

103

^{103}Rh

102.905 500

100%

46

Palladium

106

^{106}Pd

105.903 478

27.33%

47

Silver

107

^{107}Ag

106.905 092

51.84%

109

^{109}Ag

108.904 757

48.16%

48

Cadmium

114

^{114}Cd

113.903 357

28.73%

49

Indium

115

^{115}In

114.903 880

95.7%, $^{-}$

4.4×10^{14} y

50

Tin

120

^{120}Sn

119.902 200

32.59%

51

Antimony

121

^{121}Sb

120.903 821

57.3%

52

Tellurium

130

^{130}Te

129.906 229

33.8%, $^{-}$

2.5×10^{21} y

53

Iodine

127

^{127}I

126.904 473

100%

131

^{131}I

130.906 114

$^{-}$

8.040 d

54

Xenon

132

^{132}Xe

131.904 144

26.9%

136

^{136}Xe

135.907 214

8.9%

55

Cesium

133

^{133}Cs

132.905 429

100%

134

^{134}Cs

133.906 696

EC, $^{-}$

2.06 y

56

Barium

137

^{137}Ba

136.905 812

11.23%

138

^{138}Ba

137.905 232

71.70%

57

Lanthanum

139

^{139}La

138.906 346

99.91%

58

Cerium

140

^{140}Ce

139.905 433

88.48%

59

Praseodymium

141

^{141}Pr

140.907 647

100%

60

Neodymium

142

^{142}Nd

141.907 719

27.13%

61

Promethium

145

^{145}Pm

144.912 743

EC,

17.7 y

62

Samarium

152

^{152}Sm

151.919 729

26.7%

63

Europium

153

^{153}Eu

152.921 225

52.2%

64

Gadolinium

158

^{158}Gd

157.924 099

24.84%

65

Terbium

159

^{159}Tb

158.925 342

100%

66

Dysprosium

164

^{164}Dy

163.929 171

28.2%

67

Holmium

165

^{165}Ho

164.930 319

100%

68

Erbium

166

^{166}Ho

165.930 290

33.6%

69

Thulium

169

^{169}Tm

168.934 212

100%

70

Ytterbium

174

^{174}Yb

173.938 859

31.8%

71

Lutecium

175

^{175}Lu

174.940 770

97.41%

72

Hafnium

180

^{180}Hf

179.946 545

35.10%

73

Tantalum

181

^{181}Ta

180.947 992

99.98%

74

Tungsten

184

^{184}W

183.950 928

30.67%

75

Rhenium

187

^{187}Re

186.955 744

62.6%, $^{-}$

4.6×10^{10}y

76

Osmium

191

^{191}Os

190.960 920

$^{-}$

15.4 d

192

^{192}Os

191.961 467

41.0%

77

Iridium

191

^{191}Ir

190.960 584

37.3%

193

^{193}Ir

192.962 917

62.7%

78

Platinum

195

^{195}Pt

194.964 766

33.8%

79

Gold

197

^{197}Au

196.966 543

100%

198

^{198}Au

197.968 217

–

2.696 d

80

Mercury

199

^{199}Hg

198.968 253

16.87%

202

^{202}Hg

201.970 617

29.86%

81

Thallium

205

^{205}Tl

204.974 401

70.48%

82

Lead

206

^{206}Pb

205.974 440

24.1%

207

^{207}Pb

206.975 872

22.1%

208

^{208}Pb

207.976 627

52.4%

210

^{210}Pb

209.984 163

, $^{-}$

22.3 y

211

^{211}Pb

210.988 735

–

36.1 min

212

^{212}Pb

211.991 871

–

10.64 h

83

Bismuth

209

^{209}Bi

208.980 374

100%

211

^{211}Bi

210.987 255

, –

2.14 min

84

Polonium

210

^{210}Po

209.982 848

138.38 d

85

Astatine

218

^{218}At

218.008 684

, –

1.6 s

86

Radon

222

^{222}Rn

222.017 570

3.82 d

87

Francium 2

223

^{223}Fr

223.019 733

, $^{-}$

21.8 min

88

Radium

226

^{226}Ra

226.025 402

1.60×10^{3} y

89

Actinium

227

^{227}Ac

227.027 750

, $^{-}$

21.8 y

90

Thorium

228

^{228}Th

228.028 715

1.91 y

232

^{232}Th

232.038 054

100%,

1.41×10^{10} y

91

Protactinium

231

^{231}Pa

231.035 880

3.28×10^{4} y

92

Uranium

233

^{233}U

233.039 628

1.59×10^{3} y

235

^{235}U

235.043 924

0.720%,

7.04×10^{8} y

236

^{236}U

236.045 562

2.34×10^7 y

238

^{238}U

238.050 784

99.2745%,

4.47×10^9 y

239

^{239}U

239.054 289

–

23.5 min

93

Neptunium

239

^{239}Np

239.052 933

–

2.355 d

94

Plutonium

239

^{239}Pu

239.052 157

2.41×10^4 y

95

Americium

243

^{243}Am

243.061 375

, fission

7.37×10^3 y

96

Curium

245

^{245}Cm

245.065 483

8.50×10^3 y

97

Berkelium

245

^{247}Bk

247.070 300

1.38×10^3 y

98

Californium

249

^{249}Cf

249.074 844

351 y

99

Einsteinium

254

^{254}Es

254.088 019

, $^-$

276 d

100

Fermium

253

^{253}Fm

253.085 173

EC,

3.00 d

101

Mendelevium

255

^{255}Md

255.091 081

EC,

27 min

102

Nobelium

255

^{255}No

255.093 260

EC,

3.1 min

103

Lawrencium

257

^{257}Lr

257.099 480

EC,

0.646 s

104

Rutherfordium

261

^{261}Rf

261.108 690

1.08 mim

105

Dubnium

262

^{262}Db

262.113 760

, fission

34 s

106

Seaborgium

263

^{263}Sg

263.11 86

, fission

0.8 s

107

Bohrium

262

^{262}Bh

262.123 1

0.102 s

108

Hassium

264

^{264}Hs

264.128 5

0.08 ms

108

Meitnerium

266

^{266}Mt

266.137 8

3.4 ms

Table A9 Atomic Masses and Decay

Table A10 Selected Radioactive Isotopes

Table A11 Submicroscopic masses

Table A12 Densities of common substances (including water at various temperatures)

Table A13 Specific heats of common substances

Table A14 Heats of fusion and vaporization for common substances

Table A15 Coefficients of thermal expansion for common substances

Table A16 Speed of sound in various substances

Table A17 Conversion of sound intensity to decibel level

Table A18 Wavelengths of visible light

Table A19 Indices of refraction

Table A20 Moments of inertia for different shapes

Table A21 Coefficients of friction for common objects on other objects

Table A22 Dielectric constants