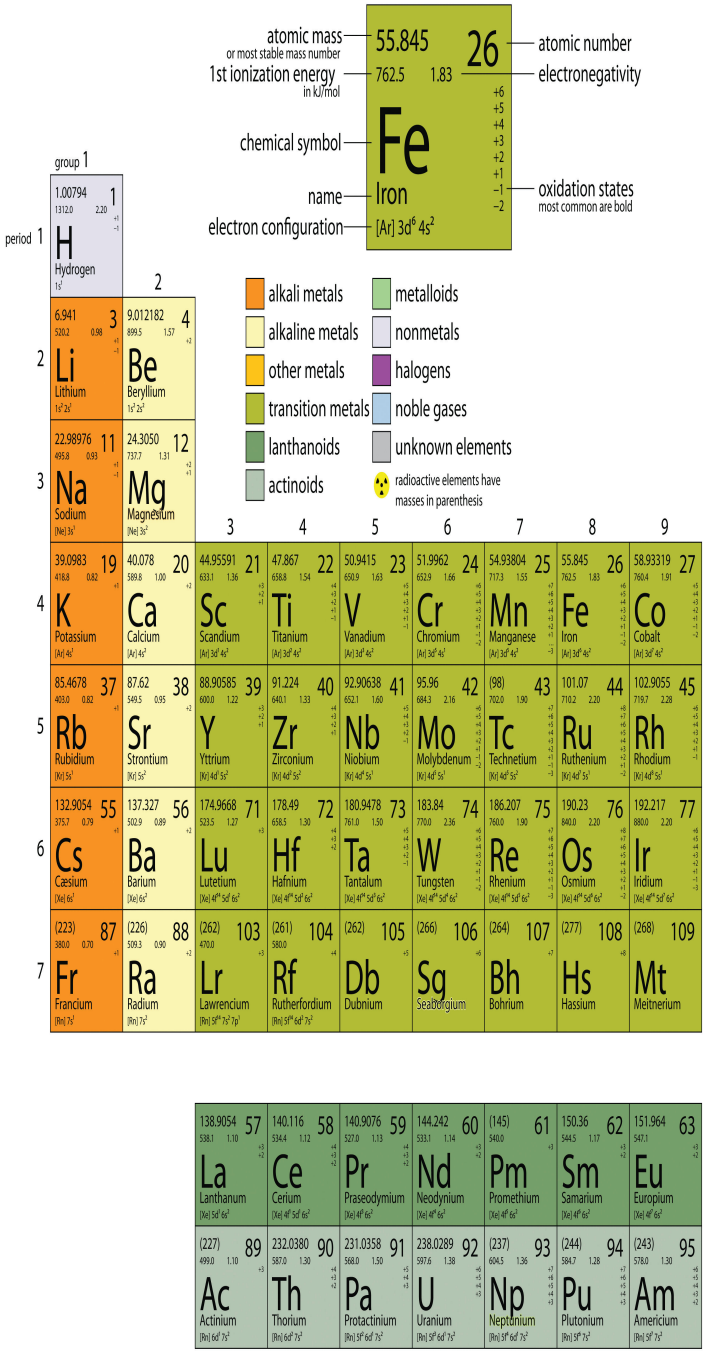
Chapter 17

Appendix: Periodic Table of the Elements

In this chapter, we present some data on the chemical elements. The periodic table, introduced in Chapter 3 "Atoms, Molecules, and Ions", lists all the known chemical elements, arranged by atomic number (that is, the number of protons in the nucleus). The periodic table is arguably the best tool in all of science; no other branch of science can summarize its fundamental constituents in such a concise and useful way. Many of the physical and chemical properties of the elements are either known or understood based on their positions on the periodic table. Periodic tables are available with a variety of chemical and physical properties listed in each element's box. What follows here is a more complex version of the periodic table than what was presented inChapter 3 "Atoms, Molecules, and Ions". The Internet is a great place to find periodic tables that contain additional information.

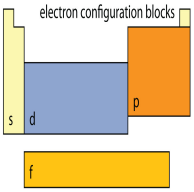
One item on most periodic tables is the atomic mass of each element. For many applications, only one or two decimal places are necessary for the atomic mass. However, some applications (especially nuclear chemistry; see Chapter 15 "Nuclear Chemistry") require more decimal places. The atomic masses in Table 17.1 "The Basics of the Elements of the Periodic Table" represent the number of decimal places recognized by the International Union of Pure and Applied Chemistry, the worldwide body that develops standards for chemistry. The atomic masses of some elements are known very precisely, to a large number of decimal places. The atomic masses of other elements, especially radioactive elements, are not known as precisely. Some elements, such as lithium, can have varying atomic masses depending on how their isotopes are isolated.

The web offers many interactive periodic table resources. For example, seehttp://www.ptable.com.



The properties listed in each box are introduced throughout the text. Atomic masses may vary by source.

by Robert Campion



notes

- as of yet, elements 112-118 have no official name designated by the IUPAC.
- 1 kJ/mol ≈ 96.485 eV.
- all elements are implied to have an oxidation state of zero.

10	11	12	13	14	15	16	17	18
								4.002602 2372.3 **2** **He** Helium $1s^2$
			10.811 800.6 2.04 **5** **B** Boron $1s^2\ 2s^2\ 2p^1$	12.0107 1086.5 2.55 **6** **C** Carbon $1s^2\ 2s^2\ 2p^2$	14.0067 1402.3 3.04 **7** **N** Nitrogen $1s^2\ 2s^2\ 2p^3$	15.9994 1313.9 3.44 **8** **O** Oxygen $1s^2\ 2s^2\ 2p^4$	18.998403 1681.0 3.98 **9** **F** Fluorine $1s^2\ 2s^2\ 2p^5$	20.1797 2080.7 **10** **Ne** Neon $1s^2\ 2s^2\ 2p^6$
			26.98153 577.5 1.61 **13** **Al** Aluminium [Ne] $3s^2\ 3p^1$	28.0855 786.5 1.90 **14** **Si** Silicon [Ne] $3s^2\ 3p^2$	30.97696 1011.8 2.19 **15** **P** Phosphorus [Ne] $3s^2\ 3p^3$	32.065 999.6 2.58 **16** **S** Sulfer [Ne] $3s^2\ 3p^4$	35.453 1251.2 3.16 **17** **Cl** Chlorine [Ne] $3s^2\ 3p^5$	39.948 1520.6 **18** **Ar** Argon [Ne] $3s^2\ 3p^6$
58.6934 737.1 1.88 **28** **Ni** Nickel [Ar] $3d^8\ 4s^2$	63.546 745.5 1.90 **29** **Cu** Copper [Ar] $3d^{10}\ 4s^1$	65.38 906.4 1.65 **30** **Zn** Zinc [Ar] $3d^{10}\ 4s^2$	69.723 578.8 1.81 **31** **Ga** Gallium [Ar] $3d^{10}\ 4s^2\ 4p^1$	72.64 762.0 2.01 **32** **Ge** Germanium [Ar] $3d^{10}\ 4s^2\ 4p^2$	74.92160 947.0 2.18 **33** **As** Arsenic [Ar] $3d^{10}\ 4s^2\ 4p^3$	78.96 941.0 2.55 **34** **Se** Selenium [Ar] $3d^{10}\ 4s^2\ 4p^4$	79.904 1139.9 2.96 **35** **Br** Bromine [Ar] $3d^{10}\ 4s^2\ 4p^5$	83.798 1350.8 3.00 **36** **Kr** Krypton [Ar] $3d^{10}\ 4s^2\ 4p^6$
106.42 804.4 2.20 **46** **Pd** Palladium [Kr] $4d^{10}$	107.8682 731.0 1.93 **47** **Ag** Silver [Kr] $4d^{10}\ 5s^1$	112.441 867.8 1.69 **48** **Cd** Cadmium [Kr] $4d^{10}\ 5s^2$	114.818 558.3 1.78 **49** **In** Indium [Kr] $4d^{10}\ 5s^2\ 5p^1$	118.710 708.6 1.96 **50** **Sn** Tin [Kr] $4d^{10}\ 5s^2\ 5p^2$	121.760 834.0 2.05 **51** **Sb** Antimony [Kr] $4d^{10}\ 5s^2\ 5p^3$	127.60 869.3 2.10 **52** **Te** Tellurium [Kr] $4d^{10}\ 5s^2\ 5p^4$	126.9044 1008.4 2.66 **53** **I** Iodine [Kr] $4d^{10}\ 5s^2\ 5p^5$	131.293 1170.4 2.60 **54** **Xe** Xenon [Kr] $4d^{10}\ 5s^2\ 5p^6$
195.084 870.0 2.28 **78** **Pt** Platinum [Xe] $4f^{14}\ 5d^9\ 6s^1$	196.9665 890.1 2.54 **79** **Au** Gold [Xe] $4f^{14}\ 5d^{10}\ 6s^1$	200.59 1007.1 2.00 **80** **Hg** Mercury [Xe] $4f^{14}\ 5d^{10}\ 6s^2$	204.3833 589.4 1.62 **81** **Tl** Thallium [Xe] $4f^{14}\ 5d^{10}\ 6s^2\ 6p^1$	207.2 715.6 2.33 **82** **Pb** Lead [Xe] $4f^{14}\ 5d^{10}\ 6s^2\ 6p^2$	208.9804 703.0 2.02 **83** **Bi** Bismuth [Xe] $4f^{14}\ 5d^{10}\ 6s^2\ 6p^3$	(210) 812.1 2.00 **84** **Po** Polonium [Xe] $4f^{14}\ 5d^{10}\ 6s^2\ 6p^4$	(210) 890.0 2.20 **85** **At** Astatine [Xe] $4f^{14}\ 5d^{10}\ 6s^2\ 6p^5$	(220) 1037.0 **86** **Rn** Radon [Xe] $4f^{14}\ 5d^{10}\ 6s^2\ 6p^6$
(271) **110** **Ds** Darmstadium	(272) **111** **Rg** Roentgenium	(285) **112** **Cn** Copernicium	(284) **113** **Uut** Ununtrium	(289) **114** **Uuq** Ununquadium	(288) **115** **Uup** Ununpentium	(292) **116** **Uuh** Ununhexium	**117** **Uus** Ununseptium	(294) **118** **Uuo** Ununoctium

157.25 593.4 1.20 **64** **Gd** Gadolinium [Xe] $4f^7\ 5d^1\ 6s^2$	158.9253 565.8 **65** **Tb** Terbium [Xe] $4f^9\ 6s^2$	162.500 573.0 1.22 **66** **Dy** Dysprosium [Xe] $4f^{10}\ 6s^2$	164.9303 581.0 1.23 **67** **Ho** Holmium [Xe] $4f^{11}\ 6s^2$	167.259 589.3 1.24 **68** **Er** Erbium [Xe] $4f^{12}\ 6s^2$	168.9342 596.7 1.25 **69** **Tm** Thulium [Xe] $4f^{13}\ 6s^2$	173.054 603.4 **70** **Yb** Ytterbium [Xe] $4f^{14}\ 6s^2$
(247) 581.0 1.30 **96** **Cm** Curium [Rn] $5f^7\ 6d^1\ 7s^2$	(247) 601.0 1.30 **97** **Bk** Berkelium [Rn] $5f^9\ 7s^2$	(251) 608.0 1.30 **98** **Cf** Californium [Rn] $5f^{10}\ 7s^2$	(252) 619.0 1.30 **99** **Es** Einsteinium [Rn] $5f^{11}\ 6s^2$	(257) 627.0 1.30 **100** **Fm** Fermium [Rn] $5f^{12}\ 7s^2$	(258) 635.0 1.30 **101** **Md** Mendelevium [Rn] $5f^{13}\ 7s^2$	(259) 642.0 1.30 **102** **No** Nobelium [Rn] $5f^{14}\ 7s^2$