

| alkali<br>metals<br>I A |                                      |  |  |  |  |  |  |  |  |  |  |  | alkaline<br>earth<br>metals<br>II A   |  |  |  |  |  |  |  |  |  | transition metals                    |  |  |  |  |  |  |  |  |  | nonmetals                                  |  |  |  |  |  |  |  |  |  | noble<br>gases<br>O                   |  |  |  |  |  |  |  |  |  |                                         |  |  |  |  |  |  |  |  |  |                                       |  |  |  |  |  |  |  |  |  |                                        |  |  |  |  |  |  |  |  |  |                                         |  |  |  |  |  |  |  |  |  |                                       |  |  |  |  |  |  |  |  |  |                                     |  |  |  |  |  |  |  |  |  |                                      |  |  |  |  |  |  |  |  |  |                                       |  |  |  |  |  |  |  |  |  |                                       |  |  |  |  |  |  |  |  |  |                                       |  |  |  |  |  |  |  |  |  |                                        |  |  |  |  |  |  |  |  |  |                                     |  |  |  |  |  |  |  |  |  |                                     |  |
|-------------------------|--------------------------------------|--|--|--|--|--|--|--|--|--|--|--|---------------------------------------|--|--|--|--|--|--|--|--|--|--------------------------------------|--|--|--|--|--|--|--|--|--|--------------------------------------------|--|--|--|--|--|--|--|--|--|---------------------------------------|--|--|--|--|--|--|--|--|--|-----------------------------------------|--|--|--|--|--|--|--|--|--|---------------------------------------|--|--|--|--|--|--|--|--|--|----------------------------------------|--|--|--|--|--|--|--|--|--|-----------------------------------------|--|--|--|--|--|--|--|--|--|---------------------------------------|--|--|--|--|--|--|--|--|--|-------------------------------------|--|--|--|--|--|--|--|--|--|--------------------------------------|--|--|--|--|--|--|--|--|--|---------------------------------------|--|--|--|--|--|--|--|--|--|---------------------------------------|--|--|--|--|--|--|--|--|--|---------------------------------------|--|--|--|--|--|--|--|--|--|----------------------------------------|--|--|--|--|--|--|--|--|--|-------------------------------------|--|--|--|--|--|--|--|--|--|-------------------------------------|--|
| Period 1                | 1<br><b>H</b><br>Hydrogen<br>1.01    |  |  |  |  |  |  |  |  |  |  |  | 2<br><b>He</b><br>Helium<br>4.00      |  |  |  |  |  |  |  |  |  |                                      |  |  |  |  |  |  |  |  |  |                                            |  |  |  |  |  |  |  |  |  |                                       |  |  |  |  |  |  |  |  |  |                                         |  |  |  |  |  |  |  |  |  |                                       |  |  |  |  |  |  |  |  |  |                                        |  |  |  |  |  |  |  |  |  |                                         |  |  |  |  |  |  |  |  |  |                                       |  |  |  |  |  |  |  |  |  |                                     |  |  |  |  |  |  |  |  |  |                                      |  |  |  |  |  |  |  |  |  |                                       |  |  |  |  |  |  |  |  |  |                                       |  |  |  |  |  |  |  |  |  |                                       |  |  |  |  |  |  |  |  |  |                                        |  |  |  |  |  |  |  |  |  |                                     |  |  |  |  |  |  |  |  |  |                                     |  |
| Period 2                | 3<br><b>Li</b><br>Lithium<br>6.94    |  |  |  |  |  |  |  |  |  |  |  | 4<br><b>Be</b><br>Beryllium<br>9.01   |  |  |  |  |  |  |  |  |  | 5<br><b>B</b><br>Boron<br>10.81      |  |  |  |  |  |  |  |  |  | 6<br><b>C</b><br>Carbon<br>12.01           |  |  |  |  |  |  |  |  |  | 7<br><b>N</b><br>Nitrogen<br>14.01    |  |  |  |  |  |  |  |  |  | 8<br><b>O</b><br>Oxygen<br>16.00        |  |  |  |  |  |  |  |  |  | 9<br><b>F</b><br>Fluorine<br>19.00    |  |  |  |  |  |  |  |  |  | 10<br><b>Ne</b><br>Neon<br>20.18       |  |  |  |  |  |  |  |  |  |                                         |  |  |  |  |  |  |  |  |  |                                       |  |  |  |  |  |  |  |  |  |                                     |  |  |  |  |  |  |  |  |  |                                      |  |  |  |  |  |  |  |  |  |                                       |  |  |  |  |  |  |  |  |  |                                       |  |  |  |  |  |  |  |  |  |                                       |  |  |  |  |  |  |  |  |  |                                        |  |  |  |  |  |  |  |  |  |                                     |  |  |  |  |  |  |  |  |  |                                     |  |
| Period 3                | 11<br><b>Na</b><br>Sodium<br>22.99   |  |  |  |  |  |  |  |  |  |  |  | 12<br><b>Mg</b><br>Magnesium<br>24.31 |  |  |  |  |  |  |  |  |  | 13<br><b>Al</b><br>Aluminum<br>26.98 |  |  |  |  |  |  |  |  |  | 14<br><b>Si</b><br>Silicon<br>28.09        |  |  |  |  |  |  |  |  |  | 15<br><b>P</b><br>Phosphorus<br>30.97 |  |  |  |  |  |  |  |  |  | 16<br><b>S</b><br>Sulfur<br>32.07       |  |  |  |  |  |  |  |  |  | 17<br><b>Cl</b><br>Chlorine<br>35.45  |  |  |  |  |  |  |  |  |  | 18<br><b>Ar</b><br>Argon<br>39.95      |  |  |  |  |  |  |  |  |  |                                         |  |  |  |  |  |  |  |  |  |                                       |  |  |  |  |  |  |  |  |  |                                     |  |  |  |  |  |  |  |  |  |                                      |  |  |  |  |  |  |  |  |  |                                       |  |  |  |  |  |  |  |  |  |                                       |  |  |  |  |  |  |  |  |  |                                       |  |  |  |  |  |  |  |  |  |                                        |  |  |  |  |  |  |  |  |  |                                     |  |  |  |  |  |  |  |  |  |                                     |  |
| Period 4                | 19<br><b>K</b><br>Potassium<br>39.10 |  |  |  |  |  |  |  |  |  |  |  | 20<br><b>Ca</b><br>Calcium<br>40.08   |  |  |  |  |  |  |  |  |  | 21<br><b>Sc</b><br>Scandium<br>44.96 |  |  |  |  |  |  |  |  |  | 22<br><b>Ti</b><br>Titanium<br>47.88       |  |  |  |  |  |  |  |  |  | 23<br><b>V</b><br>Vanadium<br>50.94   |  |  |  |  |  |  |  |  |  | 24<br><b>Cr</b><br>Chromium<br>52.00    |  |  |  |  |  |  |  |  |  | 25<br><b>Mn</b><br>Manganese<br>54.95 |  |  |  |  |  |  |  |  |  | 26<br><b>Fe</b><br>Iron<br>55.85       |  |  |  |  |  |  |  |  |  | 27<br><b>Co</b><br>Cobalt<br>58.93      |  |  |  |  |  |  |  |  |  | 28<br><b>Ni</b><br>Nickel<br>58.70    |  |  |  |  |  |  |  |  |  | 29<br><b>Cu</b><br>Copper<br>63.55  |  |  |  |  |  |  |  |  |  | 30<br><b>Zn</b><br>Zinc<br>65.39     |  |  |  |  |  |  |  |  |  | 31<br><b>Ga</b><br>Gallium<br>69.72   |  |  |  |  |  |  |  |  |  | 32<br><b>Ge</b><br>Germanium<br>72.61 |  |  |  |  |  |  |  |  |  | 33<br><b>As</b><br>Arsenic<br>74.92   |  |  |  |  |  |  |  |  |  | 34<br><b>Se</b><br>Selenium<br>78.96   |  |  |  |  |  |  |  |  |  | 35<br><b>Br</b><br>Bromine<br>79.90 |  |  |  |  |  |  |  |  |  | 36<br><b>Kr</b><br>Krypton<br>83.80 |  |
| Period 5                | 37<br><b>Rb</b><br>Rubidium<br>85.47 |  |  |  |  |  |  |  |  |  |  |  | 38<br><b>Sr</b><br>Strontium<br>87.62 |  |  |  |  |  |  |  |  |  | 39<br><b>Y</b><br>Yttrium<br>88.91   |  |  |  |  |  |  |  |  |  | 40<br><b>Zr</b><br>Zirconium<br>91.22      |  |  |  |  |  |  |  |  |  | 41<br><b>Nb</b><br>Niobium<br>92.91   |  |  |  |  |  |  |  |  |  | 42<br><b>Mo</b><br>Molybdenum<br>95.94  |  |  |  |  |  |  |  |  |  | 43<br><b>Tc</b><br>(98)               |  |  |  |  |  |  |  |  |  | 44<br><b>Ru</b><br>Ruthenium<br>101.07 |  |  |  |  |  |  |  |  |  | 45<br><b>Rh</b><br>Rhodium<br>102.91    |  |  |  |  |  |  |  |  |  | 46<br><b>Pd</b><br>Palladium<br>106.4 |  |  |  |  |  |  |  |  |  | 47<br><b>Ag</b><br>Silver<br>107.87 |  |  |  |  |  |  |  |  |  | 48<br><b>Cd</b><br>Cadmium<br>112.41 |  |  |  |  |  |  |  |  |  | 49<br><b>In</b><br>Indium<br>114.82   |  |  |  |  |  |  |  |  |  | 50<br><b>Sn</b><br>Tin<br>118.71      |  |  |  |  |  |  |  |  |  | 51<br><b>Sb</b><br>Antimony<br>121.74 |  |  |  |  |  |  |  |  |  | 52<br><b>Te</b><br>Tellurium<br>127.60 |  |  |  |  |  |  |  |  |  | 53<br><b>I</b><br>Iodine<br>126.90  |  |  |  |  |  |  |  |  |  | 54<br><b>Xe</b><br>Xenon<br>131.29  |  |
| Period 6                | 55<br><b>Cs</b><br>Cesium<br>132.91  |  |  |  |  |  |  |  |  |  |  |  | 56<br><b>Ba</b><br>Barium<br>137.33   |  |  |  |  |  |  |  |  |  | Lanthanide series<br>(see below)     |  |  |  |  |  |  |  |  |  | 72<br><b>Hf</b><br>Hafnium<br>178.49       |  |  |  |  |  |  |  |  |  | 73<br><b>Ta</b><br>Tantalum<br>180.94 |  |  |  |  |  |  |  |  |  | 74<br><b>W</b><br>Tungsten<br>183.85    |  |  |  |  |  |  |  |  |  | 75<br><b>Re</b><br>Rhenium<br>186.21  |  |  |  |  |  |  |  |  |  | 76<br><b>Os</b><br>Osmium<br>190.23    |  |  |  |  |  |  |  |  |  | 77<br><b>Ir</b><br>Iridium<br>192.22    |  |  |  |  |  |  |  |  |  | 78<br><b>Pt</b><br>Platinum<br>195.08 |  |  |  |  |  |  |  |  |  | 79<br><b>Au</b><br>Gold<br>196.97   |  |  |  |  |  |  |  |  |  | 80<br><b>Hg</b><br>Mercury<br>200.59 |  |  |  |  |  |  |  |  |  | 81<br><b>Tl</b><br>Thallium<br>204.38 |  |  |  |  |  |  |  |  |  | 82<br><b>Pb</b><br>Lead<br>207.2      |  |  |  |  |  |  |  |  |  | 83<br><b>Bi</b><br>Bismuth<br>208.98  |  |  |  |  |  |  |  |  |  | 84<br><b>Po</b><br>(209)               |  |  |  |  |  |  |  |  |  | 85<br><b>At</b><br>(210)            |  |  |  |  |  |  |  |  |  | 86<br><b>Rn</b><br>(222)            |  |
| Period 7                | 87<br><b>Fr</b><br>Francium<br>(223) |  |  |  |  |  |  |  |  |  |  |  | 88<br><b>Ra</b><br>Radium<br>(226.03) |  |  |  |  |  |  |  |  |  | Actinide series<br>(see below)       |  |  |  |  |  |  |  |  |  | 104<br><b>Rf</b><br>Rutherfordium<br>(261) |  |  |  |  |  |  |  |  |  | 105<br><b>Db</b><br>Dubnium<br>(262)  |  |  |  |  |  |  |  |  |  | 106<br><b>Sg</b><br>Seaborgium<br>(263) |  |  |  |  |  |  |  |  |  | 107<br><b>Bh</b><br>Bohrium<br>(262)  |  |  |  |  |  |  |  |  |  | 108<br><b>Hs</b><br>Hassium<br>(265)   |  |  |  |  |  |  |  |  |  | 109<br><b>Mt</b><br>Meitnerium<br>(266) |  |  |  |  |  |  |  |  |  | 110<br><b></b><br>(269)               |  |  |  |  |  |  |  |  |  | 111<br><b></b><br>(272)             |  |  |  |  |  |  |  |  |  | 112<br><b></b><br>(277)              |  |  |  |  |  |  |  |  |  |                                       |  |  |  |  |  |  |  |  |  |                                       |  |  |  |  |  |  |  |  |  |                                       |  |  |  |  |  |  |  |  |  | 118<br><b></b><br>(293)                |  |  |  |  |  |  |  |  |  |                                     |  |  |  |  |  |  |  |  |  |                                     |  |

**rare earth elements—Lanthanide series**

|           |           |        |           |              |           |           |           |            |                    |          |           |          |           |            |           |         |           |            |           |         |           |        |           |         |           |           |           |          |           |
|-----------|-----------|--------|-----------|--------------|-----------|-----------|-----------|------------|--------------------|----------|-----------|----------|-----------|------------|-----------|---------|-----------|------------|-----------|---------|-----------|--------|-----------|---------|-----------|-----------|-----------|----------|-----------|
| 57        | <b>La</b> | 58     | <b>Ce</b> | 59           | <b>Pr</b> | 60        | <b>Nd</b> | 61         | <b>Pm</b><br>(145) | 62       | <b>Sm</b> | 63       | <b>Eu</b> | 64         | <b>Gd</b> | 65      | <b>Tb</b> | 66         | <b>Dy</b> | 67      | <b>Ho</b> | 68     | <b>Er</b> | 69      | <b>Tm</b> | 70        | <b>Yb</b> | 71       | <b>Lu</b> |
| 138.91    |           | 140.12 |           | 140.91       |           | 144.24    |           | (145)      |                    | 150.4    |           | 151.96   |           | 157.25     |           | 158.93  |           | 162.50     |           | 164.93  |           | 167.26 |           | 168.93  |           | 173.04    |           | 174.97   |           |
| Lanthanum |           | Cerium |           | Praseodymium |           | Neodymium |           | Promethium |                    | Samarium |           | Europium |           | Gadolinium |           | Terbium |           | Dysprosium |           | Holmium |           | Erbium |           | Thulium |           | Ytterbium |           | Lutetium |           |

Actinide  
series

|          |           |         |           |              |           |         |          |           |           |           |                    |           |                    |        |                    |           |                    |             |                    |             |                    |         |                    |             |                    |          |                    |           |                    |
|----------|-----------|---------|-----------|--------------|-----------|---------|----------|-----------|-----------|-----------|--------------------|-----------|--------------------|--------|--------------------|-----------|--------------------|-------------|--------------------|-------------|--------------------|---------|--------------------|-------------|--------------------|----------|--------------------|-----------|--------------------|
| 89       | <b>Ac</b> | 90      | <b>Th</b> | 91           | <b>Pa</b> | 92      | <b>U</b> | 93        | <b>Np</b> | 94        | <b>Pu</b><br>(244) | 95        | <b>Am</b><br>(243) | 96     | <b>Cm</b><br>(247) | 97        | <b>Bk</b><br>(247) | 98          | <b>Cf</b><br>(251) | 99          | <b>Es</b><br>(252) | 100     | <b>Fm</b><br>(257) | 101         | <b>Md</b><br>(258) | 102      | <b>No</b><br>(259) | 103       | <b>Lr</b><br>(260) |
| Actinium |           | Thorium |           | Protactinium |           | Uranium |          | Neptunium |           | Plutonium |                    | Americium |                    | Curium |                    | Berkelium |                    | Californium |                    | Einsteinium |                    | Fermium |                    | Mendelevium |                    | Nobelium |                    | Lanthanum |                    |