

Appendices

Appendix 1 SYSTEME INTERNATIONAL (SI) STANDARD UNITS OF MEASUREMENT AND THEIR DEFINITIONS

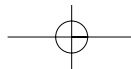
| PHYSICAL QUANTITY | NAME | UNIT | SYMBOL |
|---------------------------|-------------------------------|------|---|
| Length | metre | | m |
| Mass | kilogram | | kg |
| Time | second | | s |
| Electric current | ampere | | A |
| Thermodynamic temperature | kelvin | | K |
| Amount of substance | mole | | mol |
| Luminous intensity | candela | | cd |
| Density | kilogram per cubic metre | | kg m^{-3} |
| Velocity | metre per second | | m s^{-1} |
| Acceleration | metre per second squared | | m s^{-2} |
| Momentum | kilogram metre per second | | kg m s^{-1} |
| Frequency | hertz | | Hz ($1 \text{ Hz} = 1 \text{ s}^{-1}$) |
| Force | newton | | N ($1 \text{ N} = 1 \text{ kg m s}^{-2}$) |
| Pressure | pascal | | Pa ($1 \text{ Pa} = 1 \text{ N m}^{-2}$) |
| Energy, work | joule | | J ($1 \text{ J} = 1 \text{ N m}$) |
| Power | watt | | W ($1 \text{ W} = 1 \text{ J s}^{-1}$) |
| Electric charge | coulomb | | C ($1 \text{ C} = 1 \text{ A s}$) |
| Electric potential | volt | | V ($1 \text{ V} = 1 \text{ J C}^{-1}$) |
| Electric resistance | ohm | | Ω ($1 \Omega = 1 \text{ V A}^{-1}$) |
| Moment of force | newton metre | | N m |
| Heat capacity | joule per kelvin | | J K^{-1} |
| Specific heat capacity | joule per kilogram per kelvin | | $\text{J kg}^{-1} \text{ K}^{-1}$ |
| Specific latent heat | joule per kilogram | | J kg^{-1} |
| Electric field strength | volt per metre | | V m^{-1} |
| Electric resistivity | ohm metre | | $\Omega \text{ m}$ |
| Celsius temperature | degree Celsius | | $^{\circ}\text{C}$ |
| Pressure | standard atmosphere | | 1 atm ($1 \text{ atm} = 101\,325 \text{ Pa}$) |
| Power of lens | diopetre | | D ($1 \text{ D} = 1 \text{ m}^{-1}$) |
| Electric energy | kilowatt hour | | kWh |

Appendix 2 METRIC PREFIXES AND THEIR ORIGINS

| PREFIX | ABBREVIATION | MEANING | ORIGIN |
|----------|--------------|------------|----------------------------------|
| exa | E | 10^{18} | Greek <i>exa</i> — out of |
| peta | P | 10^{15} | Greek <i>peta</i> — spread out |
| tera | T | 10^{12} | Greek <i>teratos</i> — monster |
| giga | G | 10^9 | Greek <i>gigas</i> — giant |
| mega | M | 10^6 | Greek <i>mega</i> — great |
| kilo | k | 10^3 | Greek <i>khilioi</i> — thousand |
| hecto | h | 10^2 | Greek <i>hekatón</i> — hundred |
| deca | da | 10^1 | Greek <i>deka</i> — ten |
| baseunit | — | 10^0 | |
| deci | d | 10^{-1} | Latin <i>decimus</i> — tenth |
| centi | c | 10^{-2} | Latin <i>centum</i> — hundred |
| milli | m | 10^{-3} | Latin <i>mille</i> — thousand |
| micro | μ | 10^{-6} | Greek <i>mikros</i> — very small |
| nano | n | 10^{-9} | Greek <i>nanos</i> — dwarf |
| pico | p | 10^{-12} | Italian <i>piccolo</i> — small |
| femto | f | 10^{-15} | Greek <i>femten</i> — fifteen |
| atto | a | 10^{-18} | Danish <i>atten</i> — eighteen |

Appendix 3 PHYSICAL CONSTANTS

| QUANTITY | SYMBOL | APPROXIMATE VALUE |
|----------------------------|--------|--|
| Speed of light in a vacuum | c | $3.00 \times 10^8 \text{ m s}^{-1}$ |
| Gravitational constant | G | $6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$ |
| Coulomb's constant | k | $9.00 \times 10^9 \text{ N m}^2 \text{ C}^{-2}$ |
| Charge on electron | $-e$ | $-1.60 \times 10^{-19} \text{ C}$ |
| Charge on proton | e | $1.60 \times 10^{-19} \text{ C}$ |
| Electron mass | m_e | $9.11 \times 10^{-31} \text{ kg}$ |
| Proton mass | m_p | $1.673 \times 10^{-27} \text{ kg}$ |
| Neutron mass | m_n | $1.675 \times 10^{-27} \text{ kg}$ |
| Atomic mass unit | u | $1.660 \times 10^{-27} \text{ kg}$ |
| Boltzmann's constant | k | $1.38 \times 10^{-23} \text{ JK}^{-1}$ |
| Planck's constant | h | $6.63 \times 10^{-34} \text{ Js}$ |
| Avogadro's number | N_A | $6.02 \times 10^{23} \text{ mol}^{-1}$ |
| Magnetic constant | k | $2.0 \times 10^{-7} \text{ N A}^{-2}$ |
| Electron volt | eV | $1.6 \times 10^{-19} \text{ J}$ |

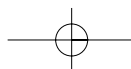


Appendix 4 THE GREEK ALPHABET

| | | | | | | | | |
|----------|------------|---------|-----------|------------|---------|------------|------------|---------|
| A | α | alpha | I | ι | iota | P | ρ | rho |
| B | β | beta | K | κ | kappa | Σ | σ | sigma |
| Γ | γ | gamma | Λ | λ | lambda | T | τ | tau |
| Δ | δ | delta | M | μ | mu | Υ | υ | upsilon |
| E | ϵ | epsilon | N | ν | nu | Φ | ϕ | phi |
| Z | ζ | zeta | Ξ | ξ | xi | X | χ | chi |
| H | η | eta | O | \omicron | omicron | Ψ | ψ | psi |
| Θ | θ | theta | Π | π | pi | Ω | ω | omega |

Appendix 5 USEFUL CONVERSION FACTORS

| | |
|--|--|
| Mass 1 tonne = 10^3 kg 1 a.m.u. = 1.6606×10^{-27} kg | Velocity 1 km h ⁻¹ = 0.2778 m s ⁻¹ |
| Length 1 km = 10^3 m 1 cm = 10^{-2} m 1 mm = 10^{-3} m 1 μ m = 10^{-6} m 1 nm = 10^{-9} m | Angle 1 rad = 57.295° 1° = 0.0175 rad |
| Volume 1 litre (L) = 1000 cm ³ = 10^{-3} m ³ 1 gallon (US) = 3.7854 L 1 gallon (UK) = 4.5461 L | Frequency 1 Hz = 1 cycle s ⁻¹ 1 rev min ⁻¹ = 0.0167 Hz |
| Density 1 g cm ⁻³ = 10^{-3} kg m ⁻³ | Force 1 N = 1 kg m s ⁻² |
| Time 1 min = 60 s 1 h = 60 min = 3600 s 1 solar day = 24 h = 1440 min = 86 400 s | Pressure 1 Pa = 1 N m ⁻² 1 atm = 1.013×10^5 Pa = 760 Torr = 760 mmHg |



Appendix 6 PERIODIC TABLE OF THE ELEMENTS

| | | | | | | | |
|------------------------------------|--|--|---|---------------------------------------|---------------------------------------|--------------------------------------|-------------------------------------|
| I A | II A | III A | IV A | V A | VI A | VII A | 2 |
| 1 H Hydrogen 1.008 | 4 Be Beryllium 9.012 | 5 B Boron 10.81 | 6 C Carbon 12.01 | 7 N Nitrogen 14.01 | 8 O Oxygen 16.00 | 9 F Fluorine 19.00 | He Helium 4.008 |
| 3 Li Lithium 6.941 | 12 Mg Magnesium 24.31 | 13 Al Aluminum 26.98 | 14 Si Silicon 28.09 | 15 P Phosphorus 30.97 | 16 S Sulfur 32.06 | 17 Cl Chlorine 35.45 | 10 Ne Neon 20.18 |
| 11 Na Sodium 22.99 | 19 K Potassium 39.10 | 19 K Potassium 39.10 | 20 Ca Calcium 40.06 | 31 Ga Gallium 69.72 | 32 Ge Germanium 72.59 | 33 As Arsenic 74.92 | 18 Ar Argon 39.95 |
| 11 Na Sodium 22.99 | 37 Rb Rubidium 85.47 | 37 Rb Rubidium 85.47 | 38 Sr Strontium 87.62 | 49 In Indium 114.8 | 50 Sn Tin 118.7 | 51 Sb Antimony 121.8 | 36 Kr Krypton 83.80 |
| 11 Na Sodium 22.99 | 55 Cs Cesium 132.9 | 55 Cs Cesium 132.9 | 56 Ba Barium 137.3 | 81 Tl Thallium 204.4 | 82 Pb Lead 207.2 | 83 Bi Bismuth 209.0 | 54 Xe Xenon 131.3 |
| 11 Na Sodium 22.99 | 87 Fr Francium (223) | 87 Fr Francium (223) | 88 Ra Radium 226.0 | 113 Uut Uut (113) | 114 Uuq Uuq (114) | 115 Uup Uup (115) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 119 Tl Thallium 204.4 | 119 Tl Thallium 204.4 | 120 Pb Lead 207.2 | 121 Uuq Uuq (121) | 122 Uub Uub (122) | 123 Uut Uut (123) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 137 Fr Francium (223) | 137 Fr Francium (223) | 138 Ra Radium 226.0 | 139 Uut Uut (139) | 140 Uuq Uuq (140) | 141 Uup Uup (141) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 187 Ts Tennessine (289) | 187 Ts Tennessine (289) | 188 Og Oganesson (289) | 189 Uut Uut (189) | 190 Uuq Uuq (190) | 191 Uup Uup (191) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 227 Fr Francium (223) | 227 Fr Francium (223) | 228 Ra Radium 226.0 | 229 Uut Uut (229) | 230 Uuq Uuq (230) | 231 Uup Uup (231) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 285 Ts Tennessine (289) | 285 Ts Tennessine (289) | 286 Og Oganesson (289) | 287 Uut Uut (287) | 288 Uuq Uuq (288) | 289 Uup Uup (289) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 349 Ts Tennessine (289) | 349 Ts Tennessine (289) | 350 Og Oganesson (289) | 351 Uut Uut (351) | 352 Uuq Uuq (352) | 353 Uup Uup (353) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 421 Ts Tennessine (289) | 421 Ts Tennessine (289) | 422 Og Oganesson (289) | 423 Uut Uut (423) | 424 Uuq Uuq (424) | 425 Uup Uup (425) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 509 Ts Tennessine (289) | 509 Ts Tennessine (289) | 510 Og Oganesson (289) | 511 Uut Uut (511) | 512 Uuq Uuq (512) | 513 Uup Uup (513) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 597 Ts Tennessine (289) | 597 Ts Tennessine (289) | 598 Og Oganesson (289) | 599 Uut Uut (599) | 600 Uuq Uuq (600) | 601 Uup Uup (601) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 685 Ts Tennessine (289) | 685 Ts Tennessine (289) | 686 Og Oganesson (289) | 687 Uut Uut (687) | 688 Uuq Uuq (688) | 689 Uup Uup (689) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 773 Ts Tennessine (289) | 773 Ts Tennessine (289) | 774 Og Oganesson (289) | 775 Uut Uut (775) | 776 Uuq Uuq (776) | 777 Uup Uup (777) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 861 Ts Tennessine (289) | 861 Ts Tennessine (289) | 862 Og Oganesson (289) | 863 Uut Uut (863) | 864 Uuq Uuq (864) | 865 Uup Uup (865) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 949 Ts Tennessine (289) | 949 Ts Tennessine (289) | 950 Og Oganesson (289) | 951 Uut Uut (951) | 952 Uuq Uuq (952) | 953 Uup Uup (953) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 1037 Ts Tennessine (289) | 1037 Ts Tennessine (289) | 1038 Og Oganesson (289) | 1039 Uut Uut (1039) | 1040 Uuq Uuq (1040) | 1041 Uup Uup (1041) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 1125 Ts Tennessine (289) | 1125 Ts Tennessine (289) | 1126 Og Oganesson (289) | 1127 Uut Uut (1127) | 1128 Uuq Uuq (1128) | 1129 Uup Uup (1129) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 1213 Ts Tennessine (289) | 1213 Ts Tennessine (289) | 1214 Og Oganesson (289) | 1215 Uut Uut (1215) | 1216 Uuq Uuq (1216) | 1217 Uup Uup (1217) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 1301 Ts Tennessine (289) | 1301 Ts Tennessine (289) | 1302 Og Oganesson (289) | 1303 Uut Uut (1303) | 1304 Uuq Uuq (1304) | 1305 Uup Uup (1305) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 1389 Ts Tennessine (289) | 1389 Ts Tennessine (289) | 1390 Og Oganesson (289) | 1391 Uut Uut (1391) | 1392 Uuq Uuq (1392) | 1393 Uup Uup (1393) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 1477 Ts Tennessine (289) | 1477 Ts Tennessine (289) | 1478 Og Oganesson (289) | 1479 Uut Uut (1479) | 1480 Uuq Uuq (1480) | 1481 Uup Uup (1481) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 1565 Ts Tennessine (289) | 1565 Ts Tennessine (289) | 1566 Og Oganesson (289) | 1567 Uut Uut (1567) | 1568 Uuq Uuq (1568) | 1569 Uup Uup (1569) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 1653 Ts Tennessine (289) | 1653 Ts Tennessine (289) | 1654 Og Oganesson (289) | 1655 Uut Uut (1655) | 1656 Uuq Uuq (1656) | 1657 Uup Uup (1657) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 1741 Ts Tennessine (289) | 1741 Ts Tennessine (289) | 1742 Og Oganesson (289) | 1743 Uut Uut (1743) | 1744 Uuq Uuq (1744) | 1745 Uup Uup (1745) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 1829 Ts Tennessine (289) | 1829 Ts Tennessine (289) | 1830 Og Oganesson (289) | 1831 Uut Uut (1831) | 1832 Uuq Uuq (1832) | 1833 Uup Uup (1833) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 1917 Ts Tennessine (289) | 1917 Ts Tennessine (289) | 1918 Og Oganesson (289) | 1919 Uut Uut (1919) | 1920 Uuq Uuq (1920) | 1921 Uup Uup (1921) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 2005 Ts Tennessine (289) | 2005 Ts Tennessine (289) | 2006 Og Oganesson (289) | 2007 Uut Uut (2007) | 2008 Uuq Uuq (2008) | 2009 Uup Uup (2009) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 2093 Ts Tennessine (289) | 2093 Ts Tennessine (289) | 2094 Og Oganesson (289) | 2095 Uut Uut (2095) | 2096 Uuq Uuq (2096) | 2097 Uup Uup (2097) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 2181 Ts Tennessine (289) | 2181 Ts Tennessine (289) | 2182 Og Oganesson (289) | 2183 Uut Uut (2183) | 2184 Uuq Uuq (2184) | 2185 Uup Uup (2185) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 2269 Ts Tennessine (289) | 2269 Ts Tennessine (289) | 2270 Og Oganesson (289) | 2271 Uut Uut (2271) | 2272 Uuq Uuq (2272) | 2273 Uup Uup (2273) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 2357 Ts Tennessine (289) | 2357 Ts Tennessine (289) | 2358 Og Oganesson (289) | 2359 Uut Uut (2359) | 2360 Uuq Uuq (2360) | 2361 Uup Uup (2361) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 2445 Ts Tennessine (289) | 2445 Ts Tennessine (289) | 2446 Og Oganesson (289) | 2447 Uut Uut (2447) | 2448 Uuq Uuq (2448) | 2449 Uup Uup (2449) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 2533 Ts Tennessine (289) | 2533 Ts Tennessine (289) | 2534 Og Oganesson (289) | 2535 Uut Uut (2535) | 2536 Uuq Uuq (2536) | 2537 Uup Uup (2537) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 2621 Ts Tennessine (289) | 2621 Ts Tennessine (289) | 2622 Og Oganesson (289) | 2623 Uut Uut (2623) | 2624 Uuq Uuq (2624) | 2625 Uup Uup (2625) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 2709 Ts Tennessine (289) | 2709 Ts Tennessine (289) | 2710 Og Oganesson (289) | 2711 Uut Uut (2711) | 2712 Uuq Uuq (2712) | 2713 Uup Uup (2713) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 2797 Ts Tennessine (289) | 2797 Ts Tennessine (289) | 2798 Og Oganesson (289) | 2799 Uut Uut (2799) | 2800 Uuq Uuq (2800) | 2801 Uup Uup (2801) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 2885 Ts Tennessine (289) | 2885 Ts Tennessine (289) | 2886 Og Oganesson (289) | 2887 Uut Uut (2887) | 2888 Uuq Uuq (2888) | 2889 Uup Uup (2889) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 2973 Ts Tennessine (289) | 2973 Ts Tennessine (289) | 2974 Og Oganesson (289) | 2975 Uut Uut (2975) | 2976 Uuq Uuq (2976) | 2977 Uup Uup (2977) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 3061 Ts Tennessine (289) | 3061 Ts Tennessine (289) | 3062 Og Oganesson (289) | 3063 Uut Uut (3063) | 3064 Uuq Uuq (3064) | 3065 Uup Uup (3065) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 3149 Ts Tennessine (289) | 3149 Ts Tennessine (289) | 3150 Og Oganesson (289) | 3151 Uut Uut (3151) | 3152 Uuq Uuq (3152) | 3153 Uup Uup (3153) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 3237 Ts Tennessine (289) | 3237 Ts Tennessine (289) | 3238 Og Oganesson (289) | 3239 Uut Uut (3239) | 3240 Uuq Uuq (3240) | 3241 Uup Uup (3241) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 3325 Ts Tennessine (289) | 3325 Ts Tennessine (289) | 3326 Og Oganesson (289) | 3327 Uut Uut (3327) | 3328 Uuq Uuq (3328) | 3329 Uup Uup (3329) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 3413 Ts Tennessine (289) | 3413 Ts Tennessine (289) | 3414 Og Oganesson (289) | 3415 Uut Uut (3415) | 3416 Uuq Uuq (3416) | 3417 Uup Uup (3417) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 3501 Ts Tennessine (289) | 3501 Ts Tennessine (289) | 3502 Og Oganesson (289) | 3503 Uut Uut (3503) | 3504 Uuq Uuq (3504) | 3505 Uup Uup (3505) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 3589 Ts Tennessine (289) | 3589 Ts Tennessine (289) | 3590 Og Oganesson (289) | 3591 Uut Uut (3591) | 3592 Uuq Uuq (3592) | 3593 Uup Uup (3593) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 3677 Ts Tennessine (289) | 3677 Ts Tennessine (289) | 3678 Og Oganesson (289) | 3679 Uut Uut (3679) | 3680 Uuq Uuq (3680) | 3681 Uup Uup (3681) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 3765 Ts Tennessine (289) | 3765 Ts Tennessine (289) | 3766 Og Oganesson (289) | 3767 Uut Uut (3767) | 3768 Uuq Uuq (3768) | 3769 Uup Uup (3769) | 86 Rn Radon (222) |
| 11 Na Sodium 22.99 | 3853 Ts Tennessine (289) | | | | | | |

Appendix 7 RELATIVE ATOMIC MASSES

| NAME | SYMBOL | ATOMIC NUMBER | RELATIVE ATOMIC MASS | NAME | SYMBOL | ATOMIC NUMBER | RELATIVE ATOMIC MASS |
|---------------|--------|---------------|----------------------|----------------|--------|---------------|----------------------|
| * Actinium | Ac | 89 | (227) | Mercury | Hg | 80 | 200.6 |
| Aluminium | Al | 13 | 27.0 | Molybdenum | Mo | 42 | 95.9 |
| * Americium | Am | 95 | (243) | Neodymium | Nd | 60 | 144.2 |
| Antimony | Sb | 51 | 121.8 | Neon | Ne | 10 | 20.2 |
| Argon | Ar | 18 | 39.9 | * Neptunium | Np | 93 | (237) |
| Arsenic | As | 33 | 74.9 | Nickel | Ni | 28 | 58.7 |
| * Astatine | At | 85 | (210) | Niobium | Nb | 41 | 92.9 |
| Barium | Ba | 56 | 137.3 | Nitrogen | N | 7 | 14.0 |
| * Berkelium | Bk | 97 | (247) | * Nobelium | No | 102 | (259) |
| Beryllium | Be | 4 | 9.0 | Osmium | Os | 76 | 190.2 |
| Bismuth | Bi | 83 | 209.0 | Oxygen | O | 8 | 16.0 |
| Boron | B | 5 | 10.8 | Palladium | Pd | 46 | 106.4 |
| Bromine | Br | 35 | 79.9 | Phosphorus | P | 15 | 31.0 |
| Cadmium | Cd | 48 | 112.4 | Platinum | Pt | 78 | 195.1 |
| Caesium | Cs | 55 | 132.9 | * Plutonium | Pu | 94 | (244) |
| Calcium | Ca | 20 | 40.1 | * Polonium | Po | 84 | (209) |
| * Californium | Cf | 98 | (251) | Potassium | K | 19 | 39.1 |
| Carbon | C | 6 | 12.0 | Praseodymium | Pr | 59 | 140.9 |
| Cerium | Ce | 58 | 140.1 | * Promethium | Pm | 61 | (145) |
| Chlorine | Cl | 17 | 35.5 | * Protactinium | Pa | 91 | (231) |
| Chromium | Cr | 24 | 52.0 | * Radium | Ra | 88 | (226) |
| Cobalt | Co | 27 | 58.9 | * Radon | Rn | 86 | (222) |
| Copper | Cu | 29 | 63.5 | Rhenium | Re | 75 | 186.2 |
| * Curium | Cm | 96 | (247) | Rhodium | Rh | 45 | 102.9 |
| Dysprosium | Dy | 66 | 162.5 | Rubidium | Rb | 37 | 85.5 |
| * Einsteinium | Es | 99 | (254) | Ruthenium | Ru | 44 | 101.1 |
| Erbium | Er | 68 | 167.3 | Rutherfordium | Rf | 104 | 261 |
| Europium | Eu | 63 | 152.0 | Samarium | Sm | 62 | 150.4 |
| * Fermium | Fm | 100 | (257) | Scandium | Sc | 21 | 45.0 |
| Fluorine | F | 9 | 19.0 | Selenium | Se | 34 | 79.0 |
| * Francium | Fr | 87 | (223) | Silicon | Si | 14 | 28.1 |
| Gadolinium | Gd | 64 | 157.3 | Silver | Ag | 47 | 107.9 |
| Gallium | Ga | 31 | 69.7 | Sodium | Na | 11 | 23.0 |
| Germanium | Ge | 32 | 72.6 | Strontium | Sr | 38 | 87.6 |
| Gold | Au | 79 | 197.0 | Sulfur | S | 16 | 32.1 |
| Hafnium | Hf | 72 | 178.5 | Tantalum | Ta | 73 | 180.9 |

Appendix 7 Cont'd

| NAME | SYMBOL | ATOMIC NUMBER | RELATIVE ATOMIC MASS | NAME | SYMBOL | ATOMIC NUMBER | RELATIVE ATOMIC MASS |
|----------------|--------|---------------|----------------------|--------------|--------|---------------|----------------------|
| Helium | He | 2 | 4.0 | * Technetium | Tc | 43 | (98) |
| Holmium | Ho | 67 | 164.9 | Tellurium | Te | 52 | 127.6 |
| Hydrogen | H | 1 | 1.0 | Terbium | Tb | 65 | 158.9 |
| Indium | In | 49 | 114.8 | Thallium | Tl | 81 | 204.4 |
| Iodine | I | 53 | 126.9 | * Thorium | Th | 90 | 232.0 |
| Iridium | Ir | 77 | 192.2 | Thulium | Tm | 69 | 168.9 |
| Iron | Fe | 26 | 55.8 | Tin | Sn | 50 | 118.7 |
| Krypton | Kr | 36 | 83.8 | Titanium | Ti | 22 | 47.9 |
| Lanthanum | La | 57 | 138.9 | Tungsten | W | 74 | 183.9 |
| * Lawrencium | Lr | 103 | (260) | * Uranium | U | 92 | 238.0 |
| Lead | Pb | 82 | 207.2 | Vanadium | V | 23 | 50.9 |
| Lithium | Li | 3 | 6.9 | Xenon | Xe | 54 | 131.3 |
| Lutetium | Lu | 71 | 175.0 | Ytterbium | Yb | 70 | 173.0 |
| Magnesium | Mg | 12 | 24.3 | Yttrium | Y | 39 | 88.9 |
| Manganese | Mn | 25 | 54.9 | Zinc | Zr | 30 | 65.4 |
| * Mendeleevium | Md | 101 | (256) | Zirconium | Zr | 40 | 91.2 |

* Unstable elements.

Value in brackets is the mass number of the isotope with the longest half-life.

Appendix 8 PROPERTIES OF THE NUCLIDES

Z = atomic number = number of protons

A = atomic mass = number of protons plus neutrons

M = exact mass of the nuclide including electrons (in u)

| Z | A | M | Z | A | M |
|------|----|-----------|------|-----|------------|
| -1e | 0 | 0.000549 | 36Kr | 84 | 83.911505 |
| 0n | 1 | 1.008665 | | 90 | 89.9197 |
| 1p | 1 | 1.007276 | | 91 | 90.923 |
| | | | | 92 | 91.92182 |
| | | | 37Rb | 90 | 89.9148 |
| 1H | 1 | 1.007825 | 38Sr | 88 | 87.905628 |
| | 2 | 2.014102 | | 90 | 89.90775 |
| | 3 | 3.016050 | | 93 | 92.9142 |
| 2He | 3 | 3.016030 | | 94 | 93.9154 |
| | 4 | 4.002603 | 42Mo | 100 | 99.9076 |
| | 6 | 6.018893 | 47Ag | 107 | 106.905091 |
| | 8 | 8.034 | | 108 | 107.905953 |
| 3Li | 6 | 6.015124 | 48Cd | 113 | 112.904408 |
| | 7 | 7.016004 | 49In | 115 | 114.90387 |
| | 8 | 8.022487 | | 116 | 115.90553 |
| | 9 | 9.02680 | 50Sn | 116 | 115.90179 |
| 4Be | 6 | 6.01972 | 52Te | 137 | 136.910 |
| | 7 | 7.016929 | 54Xe | 135 | 134.91350 |
| | 9 | 9.012186 | 55Cs | 130 | 129.90676 |
| 5B | 8 | 8.024609 | | 135 | 134.90590 |
| | 10 | 10.012938 | 56Ba | 136 | 135.90456 |
| | 11 | 11.009305 | | 141 | 140.91402 |
| 6C | 9 | 9.03104 | | 143 | 142.921 |
| | 10 | 10.01686 | | 144 | 143.923 |
| | 11 | 11.011432 | 81Tl | 208 | 207.98201 |
| | 12 | 12.000000 | 82Pb | 206 | 205.97447 |
| | 13 | 13.003354 | | 208 | 207.97666 |
| | 14 | 14.003242 | 83Bi | 212 | 211.99128 |
| 7N | 12 | 12.01864 | 84Po | 212 | 211.988865 |
| | 13 | 13.005738 | | 216 | 216.00192 |
| | 14 | 14.003074 | 86Rn | 220 | 220.01139 |
| 8O | 13 | 13.0248 | | 222 | 222.01761 |
| | 16 | 15.994915 | 88Ra | 224 | 224.02020 |
| | 17 | 16.999133 | | 226 | 226.02544 |
| | 18 | 17.999161 | | 228 | 228.03110 |
| 11Na | 22 | 21.994437 | 89Ac | 228 | 228.03104 |
| | 23 | 22.989771 | 91Pa | 234 | 234.04342 |
| | 24 | 23.990964 | 92U | 233 | 233.03965 |
| 13Al | 27 | 26.981541 | | 234 | 234.04098 |
| 15P | 30 | 29.97832 | | 235 | 235.04394 |
| | 31 | 30.973765 | | 236 | 236.04559 |
| | 32 | 31.973909 | | 238 | 238.05082 |
| 16S | 35 | 34.969033 | | 239 | 239.05433 |
| 17Cl | 36 | 35.968307 | 93Np | 239 | 239.05295 |
| 19K | 40 | 39.964000 | 94Pu | 239 | 239.05218 |
| 28Ni | 61 | 60.93106 | | 240 | 240.05384 |
| | 64 | 63.92796 | | 241 | 241.05687 |
| 29Cu | 64 | 63.929757 | 95Am | 239 | 239.05304 |
| 30Zn | 64 | 63.929140 | | 241 | 241.05685 |
| | 65 | 64.92923 | | | |