

DATA SHEET

| | |
|---------------------------------------------------------------------|---------------------------------------------------------------|
| Charge on electron, q_e | $-1.602 \times 10^{-19} \text{ C}$ |
| Mass of electron, m_e | $9.109 \times 10^{-31} \text{ kg}$ |
| Mass of neutron, m_n | $1.675 \times 10^{-27} \text{ kg}$ |
| Mass of proton, m_p | $1.673 \times 10^{-27} \text{ kg}$ |
| Speed of sound in air | 340 m s^{-1} |
| Earth's gravitational acceleration, g | 9.8 m s^{-2} |
| Speed of light, c | $3.00 \times 10^8 \text{ m s}^{-1}$ |
| Magnetic force constant, $\left(k \equiv \frac{\mu_0}{2\pi}\right)$ | $2.0 \times 10^{-7} \text{ N A}^{-2}$ |
| Universal gravitational constant, G | $6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$ |
| Mass of Earth | $6.0 \times 10^{24} \text{ kg}$ |
| Planck constant, h | $6.626 \times 10^{-34} \text{ J s}$ |
| Rydberg constant, R (hydrogen) | $1.097 \times 10^7 \text{ m}^{-1}$ |
| Atomic mass unit, u | $1.661 \times 10^{-27} \text{ kg}$ $931.5 \text{ MeV}/c^2$ |
| 1 eV | $1.602 \times 10^{-19} \text{ J}$ |
| Density of water, ρ | $1.00 \times 10^3 \text{ kg m}^{-3}$ |
| Specific heat capacity of water | $4.18 \times 10^3 \text{ J kg}^{-1} \text{ K}^{-1}$ |

FORMULAE SHEET

$$v = f\lambda$$

$$I \propto \frac{1}{d^2}$$

$$\frac{v_1}{v_2} = \frac{\sin i}{\sin r}$$

$$E = \frac{F}{q}$$

$$R = \frac{V}{I}$$

$$P = VI$$

$$\text{Energy} = VIt$$

$$v_{\text{av}} = \frac{\Delta r}{\Delta t}$$

$$a_{\text{av}} = \frac{\Delta v}{\Delta t} \quad \text{therefore} \quad a_{\text{av}} = \frac{v - u}{t}$$

$$\Sigma F = ma$$

$$F = \frac{mv^2}{r}$$

$$E_k = \frac{1}{2}mv^2$$

$$W = Fs$$

$$p = mv$$

$$\text{Impulse} = Ft$$

$$E_p = -G \frac{m_1 m_2}{r}$$

$$F = mg$$

$$v_x^2 = u_x^2$$

$$v = u + at$$

$$v_y^2 = u_y^2 + 2a_y \Delta y$$

$$\Delta x = u_x t$$

$$\Delta y = u_y t + \frac{1}{2} a_y t^2$$

$$\frac{r^3}{T^2} = \frac{GM}{4\pi^2}$$

$$F = \frac{Gm_1 m_2}{d^2}$$

$$E = mc^2$$

$$l_v = l_0 \sqrt{1 - \frac{v^2}{c^2}}$$

$$t_v = \frac{t_0}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$m_v = \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}}$$

FORMULAE SHEET

$$\frac{F}{l} = k \frac{I_1 I_2}{d}$$

$$d = \frac{1}{p}$$

$$F = BIl \sin \theta$$

$$M = m - 5 \log \left(\frac{d}{10} \right)$$

$$\tau = Fd$$

$$\frac{I_A}{I_B} = 100^{(m_B - m_A)/5}$$

$$\tau = nBIA \cos \theta$$

$$\frac{V_p}{V_s} = \frac{n_p}{n_s}$$

$$m_1 + m_2 = \frac{4\pi^2 r^3}{GT^2}$$

$$F = qvB \sin \theta$$

$$\frac{1}{\lambda} = R \left(\frac{1}{n_f^2} - \frac{1}{n_i^2} \right)$$

$$E = \frac{V}{d}$$

$$\lambda = \frac{h}{mv}$$

$$E = hf$$

$$c = f\lambda$$

$$A_0 = \frac{V_{\text{out}}}{V_{\text{in}}}$$

$$Z = \rho v$$

$$\frac{V_{\text{out}}}{V_{\text{in}}} = -\frac{R_f}{R_i}$$

$$\frac{I_r}{I_0} = \frac{[Z_2 - Z_1]^2}{[Z_2 + Z_1]^2}$$

PERIODIC TABLE OF THE ELEMENTS

| | | | | | | | | | | | | | | | | | |
|-------------------------------|----------------------------------------------------------------------------------------------|-------------------------------|-------------------------------------|-------------------------------|----------------------------------|---------------------------------|--------------------------------|----------------------------------|------------------------------------|-----------------------------------|-----------------------------------|----------------------------------|---------------------------------|------------------------------------|-----------------------------------|------------------------------------|-----------------------------------|
| 1 H 1.008 Hydrogen | KEY Atomic Number: 79 Symbol: Au Standard Atomic Weight: 197.0 Name: Gold | | | | | | | | | | | | | | | | 2 He 4.003 Helium |
| 3 Li 6.941 Lithium | 4 Be 9.012 Beryllium | | | | | | | | | | | 5 B 10.81 Boron | 6 C 12.01 Carbon | 7 N 14.01 Nitrogen | 8 O 16.00 Oxygen | 9 F 19.00 Fluorine | 10 Ne 20.18 Neon |
| 11 Na 22.99 Sodium | 12 Mg 24.31 Magnesium | | | | | | | | | | | 13 Al 26.98 Aluminium | 14 Si 28.09 Silicon | 15 P 30.97 Phosphorus | 16 S 32.07 Sulfur | 17 Cl 35.45 Chlorine | 18 Ar 39.95 Argon |
| 19 K 39.10 Potassium | 20 Ca 40.08 Calcium | 21 Sc 44.96 Scandium | 22 Ti 47.87 Titanium | 23 V 50.94 Vanadium | 24 Cr 52.00 Chromium | 25 Mn 54.94 Manganese | 26 Fe 55.85 Iron | 27 Co 58.93 Cobalt | 28 Ni 58.69 Nickel | 29 Cu 63.55 Copper | 30 Zn 65.38 Zinc | 31 Ga 69.72 Gallium | 32 Ge 72.64 Germanium | 33 As 74.92 Arsenic | 34 Se 78.96 Selenium | 35 Br 79.90 Bromine | 36 Kr 83.80 Krypton |
| 37 Rb 85.47 Rubidium | 38 Sr 87.61 Strontium | 39 Y 88.91 Yttrium | 40 Zr 91.22 Zirconium | 41 Nb 92.91 Niobium | 42 Mo 95.96 Molybdenum | 43 Tc 95.96 Technetium | 44 Ru 101.1 Ruthenium | 45 Rh 102.9 Rhodium | 46 Pd 106.4 Palladium | 47 Ag 107.9 Silver | 48 Cd 112.4 Cadmium | 49 In 114.8 Indium | 50 Sn 118.7 Tin | 51 Sb 121.8 Antimony | 52 Te 127.6 Tellurium | 53 I 126.9 Iodine | 54 Xe 131.3 Xenon |
| 55 Cs 132.9 Caesium | 56 Ba 137.3 Barium | 57–71 Lanthanoids | 72 Hf 178.5 Hafnium | 73 Ta 180.9 Tantalum | 74 W 183.9 Tungsten | 75 Re 186.2 Rhenium | 76 Os 190.2 Osmium | 77 Ir 192.2 Iridium | 78 Pt 195.1 Platinum | 79 Au 197.0 Gold | 80 Hg 200.6 Mercury | 81 Tl 204.4 Thallium | 82 Pb 207.2 Lead | 83 Bi 209.0 Bismuth | 84 Po 209.0 Polonium | 85 At 209.0 Astatine | 86 Rn 209.0 Radon |
| 87 Fr 223.0 Francium | 88 Ra 226.0 Radium | 89–103 Actinoids | 104 Rf 261.0 Rutherfordium | 105 Db 262.0 Dubnium | 106 Sg 263.0 Seaborgium | 107 Bh 264.0 Bohrium | 108 Hs 265.0 Hassium | 109 Mt 266.0 Meitnerium | 110 Ds 267.0 Darmstadtium | 111 Rg 268.0 Roentgenium | 112 Cn 269.0 Copernicium | 113 Uut 270.0 Ununtrium | 114 Fl 271.0 Flerovium | 115 Uup 272.0 Ununpentium | 116 Lv 273.0 Livermorium | 117 Uus 274.0 Ununseptium | 118 Uuo 275.0 Ununoctium |

Lanthanoids

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|--------------------------------|-----------------------------|-----------------------------------|--------------------------------|---------------------------------|-------------------------------|-------------------------------|---------------------------------|------------------------------|---------------------------------|------------------------------|-----------------------------|------------------------------|--------------------------------|-------------------------------|
| 57 La 138.9 Lanthanum | 58 Ce 140.1 Cerium | 59 Pr 140.9 Praseodymium | 60 Nd 144.2 Neodymium | 61 Pm 144.9 Promethium | 62 Sm 150.4 Samarium | 63 Eu 152.0 Europium | 64 Gd 157.3 Gadolinium | 65 Tb 158.9 Terbium | 66 Dy 162.5 Dysprosium | 67 Ho 164.9 Holmium | 68 Er 167.3 Erbium | 69 Tm 168.9 Thulium | 70 Yb 173.1 Ytterbium | 71 Lu 175.0 Lutetium |
|--------------------------------|-----------------------------|-----------------------------------|--------------------------------|---------------------------------|-------------------------------|-------------------------------|---------------------------------|------------------------------|---------------------------------|------------------------------|-----------------------------|------------------------------|--------------------------------|-------------------------------|

Actinoids

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|-------------------------------|------------------------------|-----------------------------------|-----------------------------|--------------------------------|--------------------------------|--------------------------------|-----------------------------|--------------------------------|----------------------------------|----------------------------------|-------------------------------|-----------------------------------|--------------------------------|----------------------------------|
| 89 Ac 227.0 Actinium | 90 Th 232.0 Thorium | 91 Pa 231.0 Protactinium | 92 U 238.0 Uranium | 93 Np 237.0 Neptunium | 94 Pu 244.0 Plutonium | 95 Am 243.0 Americium | 96 Cm 247.0 Curium | 97 Bk 247.0 Berkelium | 98 Cf 251.0 Californium | 99 Es 252.0 Einsteinium | 100 Fm 257.0 Fermium | 101 Md 258.0 Mendelevium | 102 No 259.0 Nobelium | 103 Lr 260.0 Lawrencium |
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Standard atomic weights are abridged to four significant figures.

Elements with no reported values in the table have no stable nuclides.

Information on elements with atomic numbers 113 and above is sourced from the International Union of Pure and Applied Chemistry Periodic Table of the Elements (January 2016 version).

The International Union of Pure and Applied Chemistry Periodic Table of the Elements (February 2010 version) is the principal source of all other data. Some data may have been modified.