

Physics

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	$3.00 \times 10^8 \text{ m s}^{-1}$
Electric permittivity constant, ϵ_0	$8.854 \times 10^{-12} \text{ A}^2 \text{ s}^4 \text{ kg}^{-1} \text{ m}^{-3}$
Magnetic permeability constant, μ_0	$4\pi \times 10^{-7} \text{ N A}^{-2}$
Universal gravitational constant, G	$6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$
Mass of Earth, M_E	$6.0 \times 10^{24} \text{ kg}$
Radius of Earth, r_E	$6.371 \times 10^6 \text{ m}$
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	$4.18 \times 10^3 \text{ J kg}^{-1} \text{ K}^{-1}$
Wien's displacement constant, b	$2.898 \times 10^{-3} \text{ m K}$

FORMULAE SHEET

Motion, forces and gravity

$$s = ut + \frac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

$$\Delta U = mg\Delta h$$

$$P = \frac{\Delta E}{\Delta t}$$

$$\sum \frac{1}{2}mv_{\text{before}}^2 = \sum \frac{1}{2}mv_{\text{after}}^2$$

$$\Delta \vec{p} = \vec{F}_{\text{net}} \Delta t$$

$$\omega = \frac{\Delta \theta}{t}$$

$$\tau = r_{\perp} F = rF \sin \theta$$

$$v = \frac{2\pi r}{T}$$

$$U = -\frac{GMm}{r}$$

$$v = u + at$$

$$\vec{F}_{\text{net}} = m\vec{a}$$

$$W = F_{\parallel} s = Fs \cos \theta$$

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

$$P = F_{\parallel} v = Fv \cos \theta$$

$$\sum m\vec{v}_{\text{before}} = \sum m\vec{v}_{\text{after}}$$

$$a_c = \frac{v^2}{r}$$

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

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

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

Waves and thermodynamics

$$v = f\lambda$$

$$f = \frac{1}{T}$$

$$d \sin \theta = m\lambda$$

$$n_x = \frac{c}{v_x}$$

$$I = I_{\text{max}} \cos^2 \theta$$

$$Q = mc\Delta T$$

$$f_{\text{beat}} = |f_2 - f_1|$$

$$f' = f \frac{(v_{\text{wave}} + v_{\text{observer}})}{(v_{\text{wave}} - v_{\text{source}})}$$

$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$

$$\sin \theta_c = \frac{n_2}{n_1}$$

$$I_1 r_1^2 = I_2 r_2^2$$

$$\frac{Q}{t} = \frac{kA\Delta T}{d}$$

FORMULAE SHEET (continued)

Electricity and magnetism

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

$$V = \frac{\Delta U}{q}$$

$$W = qV$$

$$W = qEd$$

$$B = \frac{\mu_0 I}{2\pi r}$$

$$B = \frac{\mu_0 NI}{L}$$

$$\Phi = B_{\parallel} A = BA \cos\theta$$

$$\mathcal{E} = -N \frac{\Delta\Phi}{\Delta t}$$

$$\frac{V_p}{V_s} = \frac{N_p}{N_s}$$

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

$$F = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{r^2}$$

$$I = \frac{q}{t}$$

$$V = IR$$

$$P = VI$$

$$F = qv_{\perp} B = qvB \sin\theta$$

$$F = I l_{\perp} B = I l B \sin\theta$$

$$\frac{F}{l} = \frac{\mu_0}{2\pi} \frac{I_1 I_2}{r}$$

$$\tau = n l A_{\perp} B = n l A B \sin\theta$$

$$V_p I_p = V_s I_s$$

Quantum, special relativity and nuclear

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

$$K_{\max} = hf - \phi$$

$$\lambda_{\max} = \frac{b}{T}$$

$$E = mc^2$$

$$E = hf$$

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

$$t = \frac{t_0}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}}$$

$$l = l_0 \sqrt{\left(1 - \frac{v^2}{c^2}\right)}$$

$$p_v = \frac{m_0 v}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}}$$

$$N_t = N_0 e^{-\lambda t}$$

$$\lambda = \frac{\ln 2}{t_{\frac{1}{2}}}$$

PERIODIC TABLE OF THE ELEMENTS

1 H 1.008 Hydrogen		4 Be 9.012 Beryllium		12 Mg 24.31 Magnesium		20 Ca 40.08 Calcium		38 Sr 87.61 Strontium		56 Ba 137.3 Barium		88 Ra Radium		2 He 4.003 Helium										
3 Li 6.941 Lithium		11 Na 22.99 Sodium		19 K 39.10 Potassium		37 Rb 85.47 Rubidium		55 Cs 132.9 Caesium		87 Fr Francium		5 B 10.81 Boron		13 Al 26.98 Aluminium										
6 C 12.01 Carbon		14 Si 28.09 Silicon		32 Ge 72.64 Germanium		50 Sn 118.7 Tin		82 Pb 207.2 Lead		114 Fl Flerovium		6 C 12.01 Carbon		14 Si 28.09 Silicon										
7 N 14.01 Nitrogen		15 P 30.97 Phosphorus		33 As 74.92 Arsenic		51 Sb 121.8 Antimony		83 Bi 209.0 Bismuth		115 Mc Moscovium		7 N 14.01 Nitrogen		15 P 30.97 Phosphorus										
8 O 16.00 Oxygen		16 S 32.07 Sulfur		34 Se 78.96 Selenium		52 Te 127.6 Tellurium		84 Po Polonium		116 Lv Livermorium		8 O 16.00 Oxygen		16 S 32.07 Sulfur										
9 F 19.00 Fluorine		17 Cl 35.45 Chlorine		35 Br 79.90 Bromine		53 I 126.9 Iodine		85 At Astatine		117 Ts Tennessine		9 F 19.00 Fluorine		17 Cl 35.45 Chlorine										
10 Ne 20.18 Neon		18 Ar 39.95 Argon		36 Kr 83.80 Krypton		54 Xe 131.3 Xenon		86 Rn Radon		118 Og Oganesson		10 Ne 20.18 Neon		18 Ar 39.95 Argon										
													KEY											
													Atomic Number		79									
													Symbol		Au									
													Standard Atomic Weight		197.0									
													Name		Gold									
													25		26		27		28		29		30	
													Mn		Fe		Co		Ni		Cu		Zn	
													54.94		55.85		58.93		58.69		63.55		65.38	
													Manganese		Iron		Cobalt		Nickel		Copper		Zinc	
													43		44		45		46		47		48	
													Tc		Ru		Rh		Pd		Ag		Cd	
													101.1		101.1		102.9		106.4		107.9		112.4	
													Technetium		Ruthenium		Rhodium		Palladium		Silver		Cadmium	
													75		76		77		78		79		80	
													Re		Os		Ir		Pt		Au		Hg	
													186.2		190.2		192.2		195.1		197.0		200.6	
													Rhenium		Osmium		Iridium		Platinum		Gold		Mercury	
													107		108		109		110		111		112	
													Bh		Hs		Mt		Ds		Rg		Cn	
													Bohrium		Hassium		Meitnerium		Darmstadtium		Roentgenium		Copernicium	
													61		62		63		64		65		66	
													Pm		Sm		Eu		Gd		Tb		Dy	
													Promethium		Samarium		Europium		Gadolinium		Terbium		Dysprosium	
													144.2		150.4		152.0		157.3		158.9		162.5	
													Neodymium		Samarium		Europium		Gadolinium		Terbium		Dysprosium	
													60		61		62		63		64		65	
													Nd		Pm		Sm		Eu		Gd		Tb	
													Neodymium		Promethium		Samarium		Europium		Gadolinium		Terbium	
													140.9		140.9		140.9		140.9		140.9		140.9	
													Praseodymium		Neodymium		Praseodymium		Neodymium		Terbium		Dysprosium	
													59		60		61		62		63		64	
													Pr		Nd		Pm		Sm		Eu		Gd	
													Lanthanum		Neodymium		Promethium		Samarium		Europium		Gadolinium	
													138.9		144.2		152.0		157.3		158.9		162.5	
													Lanthanum		Neodymium		Europium		Gadolinium		Terbium		Dysprosium	
													89–103		90		91		92		93		94	
													Actinoids		Th		Pa		U		Np		Pu	
													Actinoids		Thorium		Protactinium		Uranium		Neptunium		Plutonium	
													103		231.0		231.0		238.0		238.0		238.0	
													Lawrencium		Protactinium		Uranium		Neptunium		Plutonium		Americium	

Lanthanoids

57 La 138.9 Lanthanum	58 Ce 140.1 Cerium	59 Pr 140.9 Praseodymium	60 Nd 144.2 Neodymium	61 Pm 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
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Actinoids

89 Ac Actinium	90 Th 232.0 Thorium	91 Pa 231.0 Protactinium	92 U 238.0 Uranium	93 Np Neptunium	94 Pu Plutonium	95 Am Americium	96 Cm Curium	97 Bk Berkelium	98 Cf Californium	99 Es Einsteinium	100 Fm Fermium	101 Md Mendelevium	102 No Nobelium	103 Lr 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 (November 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.