

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	$5.97 \times 10^{24} \text{ kg}$
Radius of Earth, r_E	$6.371 \times 10^6 \text{ m}$
h	$6.626 \times 10^{-34} \text{ J s}$
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	$1.602 \times 10^{-19} \text{ J}$
b	$2.898 \times 10^{-3} \text{ m K}$

FORMULAE SHEET

Motion, forces and gravity

$$\vec{s} = \vec{u}t + \frac{1}{2}\vec{a}t^2$$

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

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

$$\tau = rF \sin \theta$$

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

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

$$U + KE = -\frac{GMm}{2r}$$

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

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

$$\vec{v}_{AB} = \vec{v}_A - \vec{v}_B$$

$$\vec{v}_{av} = \frac{\Delta \vec{s}}{\Delta t}$$

$$\vec{a} = \frac{\Delta \vec{v}}{\Delta t}$$

$$F_{\perp} = mg \cos \theta$$

$$F_{\parallel} = mg \sin \theta$$

$$F_x = F \cos \theta$$

$$F_y = F \sin \theta$$

$$\vec{v} = \vec{u} + \vec{a}t$$

$$\vec{F}_w = m\vec{g}$$

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

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

$$\vec{p} = m\vec{v}$$

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

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

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

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

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

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

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

$$g = \frac{GM}{r^2}$$

$$W = \Delta U$$

$$f_{\text{friction}} = \mu F_N$$

Waves

$$v = f\lambda$$

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

$$d \sin \theta = m\lambda = \frac{dy}{L}$$

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

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

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

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

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

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

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

$$E = hf$$

FORMULAE SHEET (continued)

Electricity and magnetism

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

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

$$W = qV = \Delta KE$$

$$W = qEd$$

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

$$E = \frac{1}{4\pi\epsilon_0} \frac{q}{r^2}$$

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

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

$$\Phi = BA \cos \theta$$

$$|\mathcal{E}| = N \left| \frac{\Delta \Phi}{\Delta t} \right|$$

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

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

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

$$V = IR$$

$$P = VI$$

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

$$F = I l B \sin \theta$$

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

$$V_p I_p = V_s I_s$$

$$P = I^2 R$$

$$V_{\text{series}} = V_1 + V_2 + \dots + V_n$$

$$R_{\text{series}} = R_1 + R_2 + \dots + R_n$$

$$\frac{1}{R_{\text{parallel}}} = \frac{1}{R_1} + \frac{1}{R_2} + \dots + \frac{1}{R_n}$$

$$I_{\text{parallel}} = I_1 + I_2 + \dots + I_n$$

$$c = \frac{1}{\sqrt{\epsilon_0 \mu_0}}$$

Quantum, special relativity and nuclear

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

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

$$K_{\text{max}} = qV_0$$

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

$$E = mc^2$$

$$\Delta m = m_i - m_f$$

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

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

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

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

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

PERIODIC TABLE OF THE ELEMENTS

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1 H 1.008 Hydrogen	KEY																2 He 4.003 Helium																		
3 Li 6.941 Lithium	4 Be 9.012 Beryllium	Atomic Number Symbol		79 Au 197.0 Gold		Atomic Number Symbol		8 O 16.00 Oxygen		9 F 19.00 Fluorine																									
		Standard Atomic Weight Name				Standard Atomic Weight Name																													
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 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 Polonium	85 At Astatine	86 Rn Radon
87 Fr Francium	88 Ra Radium	89–103 Actinoids	104 Rf Rutherfordium	105 Db Dubnium	106 Sg Seaborgium	107 Bh Bohrium	108 Hs Hassium	109 Mt Meitnerium	110 Ds Darmstadtium	111 Rg Roentgenium	112 Cn Copernicium	113 Nh Nihonium	114 Fl Flerovium	115 Mc Moscovium	116 Lv Livermorium	117 Ts Tennessine	118 Og Oganesson																		

Lanthanoids

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

Actinoids

89	Ac	Actinium
90	Th	Thorium
91	Pa	Protactinium
92	U	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

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.