

Periodic Table of the Elements

Atomic number, symbol, atomic mass (u). Brackets: no stable isotope; a representative mass number is shown.

1 **H** 1.008																	2 **He** 4.003
3 **Li** 6.94	4 **Be** 9.012											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
11 **Na** 22.99	12 **Mg** 24.30											13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.06	17 **Cl** 35.45	18 **Ar** 39.95
19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.87	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.84	27 **Co** 58.93	28 **Ni** 58.69	29 **Cu** 63.55	30 **Zn** 65.38	31 **Ga** 69.72	32 **Ge** 72.63	33 **As** 74.92	34 **Se** 78.97	35 **Br** 79.90	36 **Kr** 83.80
37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.95	43 **Tc** [98]	44 **Ru** 101.07	45 **Rh** 102.91	46 **Pd** 106.42	47 **Ag** 107.87	48 **Cd** 112.41	49 **In** 114.82	50 **Sn** 118.71	51 **Sb** 121.76	52 **Te** 127.60	53 **I** 126.90	54 **Xe** 131.29
55 **Cs** 132.91	56 **Ba** 137.33	**57-71**	72 **Hf** 178.49	73 **Ta** 180.95	74 **W** 183.84	75 **Re** 186.21	76 **Os** 190.23	77 **Ir** 192.22	78 **Pt** 195.08	79 **Au** 196.97	80 **Hg** 200.59	81 **Tl** 204.38	82 **Pb** 207.20	83 **Bi** 208.98	84 **Po** [209]	85 **At** [210]	86 **Rn** [222]
87 **Fr** [223]	88 **Ra** [226]	**89-103**	104 **Rf** [261]	105 **Db** [262]	106 **Sg** [266]	107 **Bh** [264]	108 **Hs** [277]	109 **Mt** [268]	110 **Ds** [281]	111 **Rg** [272]	112 **Cn** [285]	113 **Nh** [286]	114 **Fl** [289]	115 **Mc** [289]	116 **Lv** [293]	117 **Ts** [294]	118 **Og** [294]

Alkali metals · Alkaline earth · Transition metals · Post-transition · Metalloids · Nonmetals · Halogens · Noble gases · Lanthanides · Actinides

Trends Atomic radius: larger going down a group, smaller going left to right.
Ionization energy and electronegativity: larger going up and to the right (F is highest).
Fill order: 1s 2s 2p 3s 3p 4s 3d 4p 5s 4d 5p 6s 4f 5d 6p 7s 5f 6d 7p (s 2, p 6, d 10, f 14)

Lanthanides	57 **La** 138.91	58 **Ce** 140.12	59 **Pr** 140.91	60 **Nd** 144.24	61 **Pm** [145]	62 **Sm** 150.36	63 **Eu** 151.96	64 **Gd** 157.25	65 **Tb** 158.93	66 **Dy** 162.50	67 **Ho** 164.93	68 **Er** 167.26	69 **Tm** 168.93	70 **Yb** 173.04	71 **Lu** 174.97
Actinides	89 **Ac** [227]	90 **Th** 232.04	91 **Pa** 231.04	92 **U** 238.03	93 **Np** [237]	94 **Pu** [244]	95 **Am** [243]	96 **Cm** [247]	97 **Bk** [247]	98 **Cf** [251]	99 **Es** [252]	100 **Fm** [257]	101 **Md** [258]	102 **No** [259]	103 **Lr** [262]

FORMULAS AND QUICK FACTS: MATH | PHYSICS | CHEMISTRY

Algebra

Quadratic: $x = (-b \pm \sqrt{(b^2-4ac)}) / (2a)$
$a^m a^n = a^{m+n}$; $(a^m)^n = a^{mn}$; $a^{-n} = 1/a^n$
$\log(xy) = \log x + \log y$; $\log(x/y) = \log x - \log y$; $\log x^n = n \log x$; $\log_b x = \ln x / \ln b$
$y = mx + b$; $m = (y_2-y_1)/(x_2-x_1)$

Trigonometry

$\sin^2\theta + \cos^2\theta = 1$; $\tan\theta = \sin\theta / \cos\theta$
$\sin 2\theta = 2 \sin\theta \cos\theta$; $\cos 2\theta = \cos^2\theta - \sin^2\theta$
$\sin(A\pm B) = \sin A \cos B \pm \cos A \sin B$
$\cos(A\pm B) = \cos A \cos B \mp \sin A \sin B$
Law of cosines: $c^2 = a^2 + b^2 - 2ab \cos C$

Calculus

Derivatives: $x^n \to n x^{n-1}$; $e^x \to e^x$; $\ln x \to 1/x$; $\sin \to \cos$; $\cos \to -\sin$
Product: $(fg)' = f'g + fg'$; Quotient: $(f/g)' = (f'g - fg')/g^2$
Chain: $d/dx\, f(g(x)) = f'(g(x))\cdot g'(x)$
$\int x^n dx = x^{n+1}/(n+1) + C$ $(n \neq -1)$; $\int dx/x = \ln|x| + C$; $\int e^x dx = e^x + C$
$\int \sin x\, dx = -\cos x + C$; $\int \cos x\, dx = \sin x + C$; $\int \sec^2 x\, dx = \tan x + C$
By parts: $\int u\, dv = uv - \int v\, du$ (choose u by LIATE)
Series: $e^x = \Sigma\, x^n/n!$; $\sin x = x - x^3/3! + x^5/5! - \ldots$; $\cos x = 1 - x^2/2! + x^4/4! - \ldots$; $1/(1-x) = \Sigma\, x^n$ for $|x| < 1$

Probability and statistics

mean $= \Sigma x/n$; $s = \sqrt{(\Sigma(x-\text{mean})^2/(n-1))}$; $z = (x-\mu)/\sigma$
Binomial: $P(k) = C(n,k)\, p^k(1-p)^{n-k}$; mean $= np$; $\sigma = \sqrt{(np(1-p))}$
$nPr = n!/(n-r)!$; $nCr = n!/(r!(n-r)!)$
Empirical rule: 68% / 95% / 99.7% within 1σ / 2σ / 3σ
z for 90% / 95% / 99% confidence: 1.645 / 1.960 / 2.576

Motion

$v = v_0 + at$; $\Delta x = v_0 t + \frac{1}{2}at^2$
$v^2 = v_0^2 + 2a\Delta x$; $\Delta x = \frac{1}{2}(v_0+v)t$
Projectile: $x = v_0\cos\theta\cdot t$; $y = v_0\sin\theta\cdot t - \frac{1}{2}gt^2$
$a_c = v^2/r$; $v = \omega r$; $\omega = 2\pi/T$

Forces and momentum

$\Sigma F = ma$; $W = mg$; $f = \mu N$; $F_{spring} = -kx$
$F_g = Gm_1m_2/r^2$; $\tau = rF\sin\theta$
$p = mv$; impulse $J = F\Delta t = \Delta p$

Rotation

$\tau = I\alpha$; $L = I\omega$; $KE_{rot} = \frac{1}{2}I\omega^2$
I: solid sphere $(2/5)MR^2$; disk $\frac{1}{2}MR^2$; hoop MR^2; rod (center) $(1/12)ML^2$

Work and energy

$W = Fd\cos\theta$; $P = W/t$; $KE = \frac{1}{2}mv^2$
$PE_g = mgh$; $PE_{spring} = \frac{1}{2}kx^2$; $E = KE + PE$

Waves and optics

$v = f\lambda$; $f = 1/T$; $n = c/v$
$n_1\sin\theta_1 = n_2\sin\theta_2$; $1/f = 1/d_o + 1/d_i$

Electricity

$V = IR$; $P = IV = I^2R = V^2/R$
Series: $R = R_1+R_2$; parallel: $1/R = 1/R_1+1/R_2$
KCL: $\Sigma I_{in} = \Sigma I_{out}$; KVL: $\Sigma V = 0$
$F = kq_1q_2/r^2$, $k = 8.99 \times 10^9$ N·m²/C²
$E = F/q$; $C = Q/V$; $\tau = RC$

Capacitors and magnetism

C series: $1/C = 1/C_1+1/C_2$; parallel: $C = C_1+C_2$; $U = \frac{1}{2}CV^2$
$F = qvB\sin\theta$; $F = BIL\sin\theta$; $EMF = -d\Phi/dt$

Heat and fluids

$Q = mc\Delta T$; $Q = mL$ (phase change); $\Delta U = Q - W$
$\rho = m/V$; $P = F/A$; $P = P_0 + \rho gh$

Gases and moles

$PV = nRT$; $n = m/M$; $N = n\cdot N_A$; % yield = actual / theoretical × 100
M = mol solute / L solution; $M_1V_1 = M_2V_2$

Acids and bases

$pH = -\log[H^+]$; $pOH = -\log[OH^-]$; $pH + pOH = 14$ (25 °C)
$K_w = [H^+][OH^-] = 1.0 \times 10^{-14}$; $pK_a = -\log K_a$
Buffer: $pH = pK_a + \log([A^-]/[HA])$
Strong acids: HCl, HBr, HI, HNO_3, H_2SO_4, $HClO_4$
Strong bases: group 1 hydroxides, $Ca(OH)_2$, $Sr(OH)_2$, $Ba(OH)_2$

Kinetics

rate $= k[A]^m[B]^n$; 0th: $[A] = [A]_0 - kt$; 2nd: $1/[A] = 1/[A]_0 + kt$
1st: $\ln[A] = \ln[A]_0 - kt$; $t_{½} = 0.693/k$; Arrhenius: $\ln k = \ln A - E_a/RT$

Energy and equilibrium

$q = mc\Delta T$ (c of water = 4.184 J/g·°C); $\Delta G = \Delta H - T\Delta S = -RT\ln K$
$K = [C]^c[D]^d / ([A]^a[B]^b)$ for $aA + bB \rightleftharpoons cC + dD$
$E°_{cell} = E°_{cathode} - E°_{anode}$; $\Delta G° = -nFE°$; Nernst: $E = E° - (0.0592/n)\log Q$

Solubility rules

Soluble: group 1, NH_4^+, NO_3^-, $C_2H_3O_2^-$
Cl^-, Br^-, I^- soluble except Ag^+, Pb^{2+}, Hg_2^{2+}
SO_4^{2-} soluble except Ba^{2+}, Pb^{2+}, Sr^{2+}, Ca^{2+}
OH^-, S^{2-}, CO_3^{2-}, PO_4^{3-} insoluble except group 1 and NH_4^+

Common polyatomic ions

NH_4^+ ammonium; NO_3^- nitrate; SO_4^{2-} sulfate; CO_3^{2-} carbonate; PO_4^{3-} phosphate; OH^- hydroxide; HCO_3^- bicarbonate; $C_2H_3O_2^-$ acetate; MnO_4^- permanganate; CN^- cyanide

UNIT CONVERSIONS

Length
1 in = 2.54 cm
1 ft = 30.48 cm
1 yd = 0.9144 m
1 mi = 1.609 km
1 m = 3.281 ft

Mass
1 lb = 453.6 g
1 oz = 28.35 g
1 kg = 2.205 lb

Volume
1 gal = 3.785 L
1 qt = 0.9464 L
1 fl oz = 29.57 mL
1 L = 1000 cm^3

Temperature
°F = (9/5)°C + 32
K = °C + 273.15

Speed
1 mph = 0.4470 m/s
1 km/h = 0.2778 m/s

Pressure
1 atm = 101.3 kPa
= 760 mmHg
= 14.70 psi
1 bar = 100 kPa

Energy, power
1 cal = 4.184 J
1 kWh = 3.6 MJ
1 hp = 745.7 W
1 eV = 1.602×10^{-19} J

Time
1 day = 86,400 s
1 yr = 3.156×10^7 s

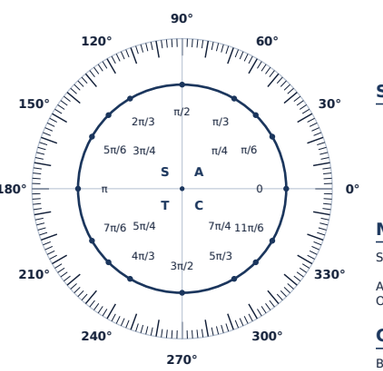
SI PREFIXES

tera	**T**	10^{12}	milli	**m**	10^{-3}
giga	**G**	10^9	micro	**μ**	10^{-6}
mega	**M**	10^6	nano	**n**	10^{-9}
kilo	**k**	10^3	pico	**p**	10^{-12}
centi	**c**	10^{-2}	femto	**f**	10^{-15}

PHYSICAL CONSTANTS

c	speed of light	2.998×10^8 m/s
g	gravity (Earth)	9.807 m/s²
G	gravitational	6.674×10^{-11} N·m²/kg²
h	Planck	6.626×10^{-34} J·s
$\mathbf{k_B}$	Boltzmann	1.381×10^{-23} J/K
$\mathbf{N_A}$	Avogadro	6.022×10^{23} /mol
R	gas constant	8.314 J/(mol·K); 0.08206 L·atm/(mol·K)
e	elem. charge	1.602×10^{-19} C
$\mathbf{m_e}$	electron mass	9.109×10^{-31} kg
$\mathbf{m_p}$	proton mass	1.673×10^{-27} kg
$\boldsymbol{\varepsilon_0}$	permittivity	8.854×10^{-12} F/m
F	Faraday	96,485 C/mol
$\mathbf{V_m}$	gas molar vol.	22.41 L/mol (0 °C, 1 atm)

UNIT CIRCLE AND PROTRACTOR



Protractor: put the center on the vertex and read the ring (ticks every 2°, long ticks every 10°). Inside: radians. A S T C: All, Sin, Tan, Cos are positive.

GREEK ALPHABET

Α α alpha	Β β beta	Γ γ gamma	Δ δ delta	Ε ε epsilon	Ζ ζ zeta	Η η eta	Θ θ theta
Ι ι iota	Κ κ kappa	Λ λ lambda	Μ μ mu	Ν ν nu	Ξ ξ xi	Ο ο omicron	Π π pi
Ρ ρ rho	Σ σ sigma	Τ τ tau	Υ υ upsilon	Φ φ phi	Χ χ chi	Ψ ψ psi	Ω ω omega

SPECIAL ANGLES

θ	0°	30°	45°	60°	90°
rad	0	π/6	π/4	π/3	π/2
sin	0	1/2	√2/2	√3/2	1
cos	1	√3/2	√2/2	1/2	0
tan	0	√3/3	1	√3	—

MEMORY AIDS

SOH CAH TOA: sin = opp/hyp, cos = adj/hyp, tan = opp/adj
All Students Take Calculus: quadrants I, II, III, IV
OIL RIG: oxidation is loss, reduction is gain (of electrons)

COMPUTER SCIENCE

Big-O: $1 < \log n < n < n \log n < n^2 < 2^n < n!$
De Morgan: $\neg(A \wedge B) = \neg A \vee \neg B$; $\neg(A \vee B) = \neg A \wedge \neg B$
ASCII: '0' = 48, 'A' = 65, 'a' = 97

RESISTOR COLOR CODE

0 black	1 brown	2 red	3 orange	4 yellow	5 green	6 blue	7 violet	8 gray	9 white	5% gold	10% silver

NUMBER SYSTEMS

dec	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
bin	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
hex	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F

Powers of 2: $2^4 = 16$ $2^8 = 256$ $2^{10} = 1{,}024$ $2^{16} = 65{,}536$ $2^{32} \approx 4.29\times10^9$

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Reference only. Values are rounded, so check your textbook for work that matters. Rulers are printed to scale but are not for precise measurement. Not for use during exams unless your instructor allows reference materials. SD Active is an independent student-run community, not affiliated with UC San Diego.

