



1	Periodic Table of the Elements																2						
1.008	Atomic number, symbol, atomic mass (u). Brackets: no stable isotope; a representative mass number is shown.																4.003						
3	4	Alkali metalsAlkaline earthTransition metalsPost-transitionMetalloidsNonmetalsHalogensNoble gasesLanthanidesActinides										5	6	7	8	9	10						
6.94	9.012	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)																10.81	12.01	14.01	16.00	19.00	20.18
11	12																	13	14	15	16	17	18
22.99	24.30																	26.98	28.09	30.97	32.06	35.45	39.95
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36						
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54						
85.47	87.62	88.91	91.22	92.91	95.95	[98]	101.07	102.91	106.42	107.87	112.41	114.82	118.71	121.76	127.60	126.90	131.29						
55	56	57-71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86						
132.91	137.33		178.49	180.95	183.84	186.21	190.23	192.22	195.08	196.97	200.59	204.38	207.20	208.98	[209]	[210]	[222]						
87	88	89-103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118						
[223]	[226]		[261]	[262]	[266]	[264]	[277]	[268]	[281]	[272]	[285]	[286]	[289]	[289]	[293]	[294]	[294]						

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

FORMULAS AND QUICK FACTS: MATH | PHYSICS | CHEMISTRY

Algebra
Quadratic: $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
 $a^m a^n = a^{m+n}$; $(a^m)^n = a^{mn}$; $a^{-n} = 1/a^n$
 $\log(xy) = \log x + \log y$; $\log(x/y) = \log x - \log y$; $\log x^n = n \log x$; $\log_b x = \ln x / \ln b$
 $y = mx + b$; $m = (y_2 - y_1) / (x_2 - x_1)$
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: $x^n \rightarrow n x^{n-1}$; $e^x \rightarrow e^x$; $\ln x \rightarrow 1/x$; $\sin \rightarrow \cos$; $\cos \rightarrow -\sin$
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: $e^x = \sum x^n/n!$; $\sin x = x - x^3/3! + x^5/5! - \dots$; $\cos x = 1 - x^2/2! + x^4/4! - \dots$; $1/(1-x) = \sum x^n$ for $|x| < 1$
Probability and statistics
mean = $\sum x/n$; $s = \sqrt{(\sum (x - \text{mean})^2)/(n-1)}$; $z = (x - \mu)/\sigma$
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: $x = v_0 \cos \theta t$; $y = v_0 \sin \theta t - \frac{1}{2}gt^2$
 $a_c = v^2/r$; $v = \omega r$; $\omega = 2\pi/T$
Forces and momentum
 $\Sigma F = ma$; $W = mg$; $f = \mu N$; $F_{\text{spring}} = -kx$
 $F_g = Gm_1 m_2 / r^2$; $\tau = rF \sin \theta$
 $p = mv$; impulse $J = F\Delta t = \Delta p$
Rotation
 $\tau = I\alpha$; $L = I\omega$; $KE_{\text{rot}} = \frac{1}{2}I\omega^2$
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
 $W = Fd \cos \theta$; $P = W/t$; $KE = \frac{1}{2}mv^2$
 $PE_g = mgh$; $PE_{\text{spring}} = \frac{1}{2}kx^2$; $E = KE + PE$
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: $\Sigma I_{\text{in}} = \Sigma I_{\text{out}}$; KVL: $\Sigma V = 0$
 $F = kq_1 q_2 / r^2$; $k = 8.99 \times 10^9 \text{ N}\cdot\text{m}^2/\text{C}^2$
 $E = F/q$; $C = Q/V$; $\tau = RC$
Capacitors and magnetism
C series: $1/C = 1/C_1 + 1/C_2$; parallel: $C = C_1 + C_2$; $U = \frac{1}{2}CV^2$
 $F = qvB \sin \theta$; $F = BIL \sin \theta$; $\text{EMF} = -d\Phi/dt$
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 $\times 100$
 $M = \text{mol solute} / \text{L solution}$; $M_1 V_1 = M_2 V_2$
Acids and bases
 $\text{pH} = -\log[\text{H}^+]$; $\text{pOH} = -\log[\text{OH}^-]$; $\text{pH} + \text{pOH} = 14$ (25 °C)
 $K_w = [\text{H}^+][\text{OH}^-] = 1.0 \times 10^{-14}$; $\text{p}K_a = -\log K_a$
Buffer: $\text{pH} = \text{p}K_a + \log([\text{A}^-]/[\text{HA}])$
Strong acids: HCl, HBr, HI, HNO₃, H₂SO₄, HClO₄
Strong bases: group 1 hydroxides, Ca(OH)₂, Sr(OH)₂, Ba(OH)₂
Kinetics
rate = $k[\text{A}]^m[\text{B}]^n$; 0th: $[\text{A}] = [\text{A}]_0 - kt$; 2nd: $1/[\text{A}] = 1/[\text{A}]_0 + kt$
1st: $\ln[\text{A}] = \ln[\text{A}]_0 - kt$; $t_{1/2} = 0.693/k$; Arrhenius: $\ln k = \ln A - E_a/RT$
Energy and equilibrium
 $q = mc\Delta T$ (c of water = 4.184 J/g·°C); $\Delta G = \Delta H - T\Delta S = -RT \ln K$
 $K = [\text{C}][\text{D}]^d / ([\text{A}]^a[\text{B}]^b)$ for $a\text{A} + b\text{B} \rightleftharpoons c\text{C} + d\text{D}$
 $E^\circ_{\text{cell}} = E^\circ_{\text{cathode}} - E^\circ_{\text{anode}}$; $\Delta G^\circ = -nFE^\circ$; Nernst: $E = E^\circ - (0.0592/n) \log Q$
Solubility rules
Soluble: group 1, NH₄⁺, NO₃⁻, C₂H₃O₂⁻
Cl⁻, Br⁻, I⁻ soluble except Ag⁺, Pb²⁺, Hg₂²⁺
SO₄²⁻ soluble except Ba²⁺, Pb²⁺, Sr²⁺, Ca²⁺
OH⁻, S²⁻, CO₃²⁻, PO₄³⁻ insoluble except group 1 and NH₄⁺
Common polyatomic ions
NH₄⁺ ammonium; NO₃⁻ nitrate; SO₄²⁻ sulfate; CO₃²⁻ carbonate; PO₄³⁻ phosphate; OH⁻ hydroxide; HCO₃⁻ bicarbonate; C₂H₃O₂⁻ acetate; MnO₄⁻ 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	Volume 1 gal = 3.785 L 1 qt = 0.9464 L 1 fl oz = 29.57 mL 1 L = 1000 cm ³	Pressure 1 atm = 101.3 kPa = 760 mmHg = 14.70 psi 1 bar = 100 kPa
Mass 1 lb = 453.6 g 1 oz = 28.35 g 1 kg = 2.205 lb	Temperature °F = (9/5)°C + 32 K = °C + 273.15	Energy, power 1 cal = 4.184 J 1 kWh = 3.6 MJ 1 hp = 745.7 W 1 eV = 1.602×10 ⁻¹⁹ J
Speed 1 mph = 0.4470 m/s 1 km/h = 0.2778 m/s		Time 1 day = 86,400 s 1 yr = 3.156×10 ⁷ s

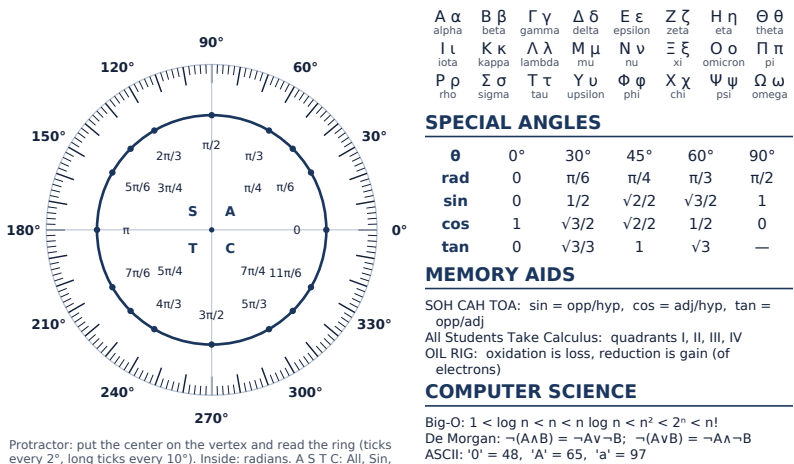
SI PREFIXES

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/s ²
G	gravitational	6.674×10 ⁻¹¹ N·m ² /kg ²
h	Planck	6.626×10 ⁻³⁴ J·s
k_B	Boltzmann	1.381×10 ⁻²³ J/K
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
m_e	electron mass	9.109×10 ⁻³¹ kg
m_p	proton mass	1.673×10 ⁻²⁷ kg
ε₀	permittivity	8.854×10 ⁻¹² F/m
F	Faraday	96,485 C/mol
V_m	gas molar vol.	22.41 L/mol (0 °C, 1 atm)

UNIT CIRCLE AND PROTRACTOR GREEK ALPHABET



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 < n² < 2ⁿ < n!
De Morgan: ¬(A∧B) = ¬A∨¬B; ¬(A∨B) = ¬A∧¬B
ASCII: '0' = 48, 'A' = 65, 'a' = 97

RESISTOR COLOR CODE

0	1	2	3	4	5	6	7	8	9	5%	10%
black	brown	red	orange	yellow	green	blue	violet	gray	white	gold	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: 2⁴ = 16 2⁸ = 256 2¹⁰ = 1,024 2¹⁶ = 65,536 2³² ≈ 4.29×10⁹



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.
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