
Energy eigenvalues:

Particle in a box: $E_n = \frac{n^2 h^2}{8mL^2}$

Harmonic oscillator: $E_n = h\nu_0(n + \frac{1}{2}), \nu_0 = \frac{1}{2\pi} \sqrt{\frac{k}{\mu}}$

Rigid rotor (Particle on a sphere): $E_{lm} = \frac{\hbar^2}{2I} l(l+1), I = \mu r^2$

One-electron atom: $E_{nlm} = -hc\mathfrak{R} \frac{Z^2}{n^2}, \mathfrak{R} = \frac{\mu e^4}{8h^3 c \epsilon_0^2}$

Morse oscillator: $E_v = hc(v + \frac{1}{2}) \tilde{\nu}_0 - hc(v + \frac{1}{2})^2 x_e \tilde{\nu}_0$

Linear or spherical rotors: $E_J = hc\tilde{B}J(J+1), \tilde{B} = \frac{\hbar}{4\pi c I_b}$

Symmetric rotors (A≠B=C): $E_{JK} = hc\tilde{B}J(J+1) + hc(\tilde{A} - \tilde{B})K^2$

Energy eigenfunctions:

Particle in a box: $\Psi_n(x) = N_n \sin\left(\frac{n\pi x}{L}\right), N_n = \left[\frac{2}{L}\right]^{1/2}$

Harmonic oscillator: $\Psi_n(x) = N_n H_n(y) e^{-y^2/2}, y = \frac{1}{\alpha} x, \alpha = \left(\frac{\hbar^2}{k\mu}\right)^{1/4}, N_n = \left[\frac{1}{\alpha\pi^{1/2} 2^n n!}\right]^{1/2}$

examples: $\Psi_0(x) = \left[\frac{1}{\alpha\pi^{1/2}}\right]^{1/2} e^{-x^2/2\alpha^2}, \Psi_1(x) = \left[\frac{1}{\alpha\pi^{1/2} 2}\right]^{1/2} \frac{2}{\alpha} x e^{-x^2/2\alpha^2}$

Hermite polynomials: $H_0(y) = 1, H_1(y) = 2y, H_2(y) = 4y^2 - 2, H_3(y) = 8y^3 - 12y$

Rigid rotor: $Y_{lm}(\theta, \phi) = N_{lm} P_l^{|m|}(u) e^{im\phi}, u = \cos\theta$

examples: $Y_{1,\pm 1}(\theta, \phi) = \mp \sqrt{\frac{3}{8\pi}} (\sin\theta) (e^{\pm i\phi}), Y_{2,0}(\theta, \phi) = \sqrt{\frac{5}{16\pi}} (3\cos^2\theta - 1)$

Radial wave function: $R_{nl}(r) = N_{nl} \rho^l L_{n+l}^{2l+1}(\rho) e^{-\rho/2}, \rho = \frac{2Z}{na_0} r$

examples: $R_{1,0}(r) = 2(Z/a_0)^{3/2} e^{-\rho/2},$
 $R_{2,0}(r) = 8^{-1/2} (Z/a_0)^{3/2} (2 - \rho) e^{-\rho/2},$
 $R_{2,1}(r) = 24^{-1/2} (Z/a_0)^{3/2} \rho e^{-\rho/2},$
 $R_{3,0}(r) = 243^{-1/2} (Z/a_0)^{3/2} (6 - 6\rho + \rho^2) e^{-\rho/2}$

One-electron atom: $\Psi_{nlm}(r, \theta, \phi) = R_{nl}(r) Y_{lm}(\theta, \phi)$

Fundamental constants:

$h = 6.62608 \times 10^{-34} \text{ J s}$	$\text{amu} = 1.66054 \times 10^{-27} \text{ kg}$	$c = 2.99792 \times 10^{10} \text{ cm s}^{-1}$
$\hbar = 1.05457 \times 10^{-34} \text{ J s}$	$m_e = 9.10939 \times 10^{-31} \text{ kg}$	$\mathfrak{R}_H = 1.09677 \times 10^5 \text{ cm}^{-1}$
$a_0 = 5.29177 \times 10^{-11} \text{ m}$	$m_n = 1.67493 \times 10^{-27} \text{ kg}$	$\mathfrak{R}_\infty = 1.09737 \times 10^5 \text{ cm}^{-1}$
$k = 1.38066 \times 10^{-23} \text{ J K}^{-1}$	$m_p = 1.67262 \times 10^{-27} \text{ kg}$	$N_{\text{AVO}} = 6.02214 \times 10^{23}$

Other quantities:

Operators: $\hat{J}_z = -i\hbar \frac{\partial}{\partial \phi}$

$$\hat{J}^2 = -\hbar^2 \left[\frac{1}{\sin \theta} \frac{\partial}{\partial \theta} \left(\sin \theta \frac{\partial}{\partial \theta} \right) + \frac{1}{\sin^2 \theta} \frac{\partial^2}{\partial \phi^2} \right]$$

$$\bar{\nabla}^2 = \frac{1}{r^2} \frac{\partial}{\partial r} \left(r^2 \frac{\partial}{\partial r} \right) + \frac{1}{r^2 \sin \theta} \frac{\partial}{\partial \theta} \left(\sin \theta \frac{\partial}{\partial \theta} \right) + \frac{1}{r^2 \sin^2 \theta} \frac{\partial^2}{\partial \phi^2}$$

Orbital overlap: if $\Psi_{\pm} = N_{\pm}(A \pm B)$, then $N_{\pm} = [2(1 \pm S)]^{-1/2}$ and $E_{\pm} = \frac{E_0 \pm H_{AB}}{1 \pm S}$

Trigonometric identities:

$$\begin{aligned} \sin \alpha \sin \beta &= \frac{1}{2} \cos(\alpha - \beta) - \frac{1}{2} \cos(\alpha + \beta) \\ \cos \alpha \cos \beta &= \frac{1}{2} \cos(\alpha - \beta) + \frac{1}{2} \cos(\alpha + \beta) \\ \sin \alpha \cos \beta &= \frac{1}{2} \sin(\alpha - \beta) + \frac{1}{2} \sin(\alpha + \beta) \\ e^{\pm i\theta} &= \cos \theta \pm i \sin \theta \end{aligned}$$

Integrals (n denotes positive integer): $\int_0^{\infty} x^n e^{-ax} dx = \frac{n!}{a^{n+1}}$

$$\int_0^{\infty} e^{-ax^2} dx = \sqrt{\frac{\pi}{4a}}$$

$$\int_0^{\infty} x^{2n} e^{-ax^2} dx = \frac{1 \cdot 3 \cdot 5 \cdots (2n-1)}{2^{n+1} a^n} \sqrt{\frac{\pi}{a}}$$

$$\int_0^{\infty} x^{2n+1} e^{-ax^2} dx = \frac{n!}{2a^{n+1}}$$

Periodic Table of the Elements 2016

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 H 1.008																	2 He 4.0026
3 Li 6.94	4 Be 9.0122											5 B 10.81	6 C 12.011	7 N 14.007	8 O 15.999	9 F 18.998	10 Ne 20.18
11 Na 22.99	12 Mg 24.305											13 Al 26.982	14 Si 28.085	15 P 30.974	16 S 32.06	17 Cl 35.45	18 Ar 39.948
19 K 39.098	20 Ca 40.078	21 Sc 44.956	22 Ti 47.867	23 V 50.942	24 Cr 51.996	25 Mn 54.938	26 Fe 55.845	27 Co 58.933	28 Ni 58.693	29 Cu 63.546	30 Zn 65.38	31 Ga 69.723	32 Ge 72.63	33 As 74.922	34 Se 78.96	35 Br 79.904	36 Kr 83.798
37 Rb 85.468	38 Sr 87.62	39 Y 88.906	40 Zr 91.224	41 Nb 92.906	42 Mo 95.96	43 Tc [97.91]	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 127.6	53 I 126.9	54 Xe 131.29
55 Cs 132.91	56 Ba 137.33	*	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 207.2	83 Bi 208.98	84 Po [208.98]	85 At [209.99]	86 Rn [222.02]
87 Fr [223.02]	88 Ra [226.03]	**	104 Rf [265.12]	105 Db [268.13]	106 Sg [271.13]	107 Bh [270]	108 Hs [277.15]	109 Mt [276.15]	110 Ds [281.16]	111 Rg [280.16]	112 Cn [285.17]	113 Nh [284.18]	114 Fl [289.19]	115 Mc [288.19]	116 Lv [293]	117 Ts [294]	118 Og [294]

Lanthanoids	57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm [144.91]	62 Sm 150.36	63 Eu 151.96	64 Gd 157.25	65 Tb 158.93	66 Dy 162.5	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.05	71 Lu 174.97
Actinoids	89 Ac [227.03]	90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np [237.05]	94 Pu [244.06]	95 Am [243.06]	96 Cm [247.07]	97 Bk [247.07]	98 Cf [251.08]	99 Es [252.08]	100 Fm [257.10]	101 Md [258.10]	102 No [259.10]	103 Lr [262.11]