
Energy eigenvalues:

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

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

Energy eigenfunctions:

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

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

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

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

Fundamental constants:

$h = 6.62608 \times 10^{-34} \text{ J s}$

$m_e = 9.10939 \times 10^{-31} \text{ kg}$

$\text{amu} = 1.66054 \times 10^{-27} \text{ kg}$

$\hbar = 1.05457 \times 10^{-34} \text{ J s}$

$m_n = 1.67493 \times 10^{-27} \text{ kg}$

$c = 2.99792 \times 10^{10} \text{ cm s}^{-1}$

$N_{\text{AVO}} = 6.02214 \times 10^{23}$

$m_p = 1.67262 \times 10^{-27} \text{ kg}$

Other quantities:

Trigonometric identities:
$$\sin \alpha \sin \beta = \frac{1}{2} \cos(\alpha - \beta) - \frac{1}{2} \cos(\alpha + \beta)$$

$$\cos \alpha \cos \beta = \frac{1}{2} \cos(\alpha - \beta) + \frac{1}{2} \cos(\alpha + \beta)$$

$$\sin \alpha \cos \beta = \frac{1}{2} \sin(\alpha - \beta) + \frac{1}{2} \sin(\alpha + \beta)$$

$$e^{\pm i\theta} = \cos \theta \pm i \sin \theta$$

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

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

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

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

Things students should memorize (NOT A COMPLETE LIST):

Classical physics formulae (p, Ek, V_{HO}, reduced mass μ)

De Broglie wavelength and photoelectron effect

Photon property relations (energy, frequency, wavenumber, wavelength)

Operators (position, momentum, potential energy, kinetic energy)

Probability and expectation value integrals, variance, uncertainty, uncertainty principle

Definitions (operator, zero-point energy, superposition, orthogonal, tunnelling...)

Lowest allowed values of quantum numbers