UNIVERSITY OF CALIFORNIA, SANTA BARBARA
Department of Physics

Physics 115A
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FINAL EXAM

Information

$\hbar = 1 \times 10^{-34}$ joule-sec

$m_e = 9 \times 10^{-31}$ kg

$e = 1.6 \times 10^{-19}$ coulombs

$\psi(x,0) = \frac{1}{\sqrt{2\pi\hbar}} \int_{-\infty}^{\infty} \bar{\psi}(p) e^{\frac{ipx}{\hbar}} dp$

$\bar{\psi}(p) = \frac{1}{\sqrt{2\pi\hbar}} \int_{-\infty}^{\infty} \psi(x,0) e^{\frac{-ipx}{\hbar}} dx$

$\psi(\vec{r},t) = \sum_n c_n \phi_n(\vec{r}) e^{\frac{-iE_n t}{\hbar}}$

$\phi_n(x) = \sqrt{\frac{2}{a}} \sin \frac{n\pi x}{a}$ $\qquad E_n = \frac{n^2\pi^2\hbar^2}{2ma^2}$

$p = -i\hbar \frac{\partial}{\partial x}$ $\qquad x = i\hbar \frac{\partial}{\partial p}$ $\qquad [X,P] = i\hbar$

$\dot{q}_i = \frac{\partial H}{\partial p_i}$, $\qquad \dot{p}_i = -\frac{\partial H}{\partial q_i}$

$\langle A \rangle = \langle \psi | A | \psi \rangle$

$\Delta A = \sqrt{\langle (A - \langle A \rangle)^2 \rangle} = \sqrt{\langle A^2 \rangle - \langle A \rangle^2}$

$i\hbar \frac{d}{dt} |\psi(t)\rangle = H(t) |\psi(t)\rangle$

$\frac{d}{dt} \langle A \rangle = \frac{1}{i\hbar} \langle [A, H(t)] \rangle + \langle \frac{\partial A}{\partial t} \rangle$

$S_z |+\rangle = \frac{\hbar}{2} |+\rangle$

$S_z = \frac{\hbar}{2} \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}, S_x = \frac{\hbar}{2} \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}, S_y = \frac{\hbar}{2} \begin{pmatrix} 0 & -i \\ i & 0 \end{pmatrix}$

$S_u = \frac{\hbar}{2} \begin{pmatrix} \cos\theta & \sin\theta e^{-i\phi} \\ \sin\theta e^{i\phi} & -\cos\theta \end{pmatrix}$

$|\pm\rangle_x = \frac{1}{\sqrt{2}} [|+\rangle \pm |-\rangle]$

$|\pm\rangle_y = \frac{1}{\sqrt{2}} [|+\rangle \pm i|-\rangle]$

$|+\rangle_u = \cos\frac{\theta}{2} e^{-i\phi/2} |+\rangle + \sin\frac{\theta}{2} e^{i\phi/2} |-\rangle$

$|-\rangle_u = -\sin\frac{\theta}{2} e^{-i\phi/2} |+\rangle + \cos\frac{\theta}{2} e^{i\phi/2} |-\rangle$

$W = -\vec{\mu} \cdot \vec{B}$ $\qquad \vec{\mu} = \gamma \vec{S}$

$H = \frac{P^2}{2m} + \frac{1}{2} m\omega^2 X^2$