Chemistry 455A

Second Exam
May 25, 2007

Name _____

Helpful Information:

$H\Psi = E\Psi$	$\hbar = 1.\cdot 10^{-34} J - \sec$	$E_n = \hbar\omega_{os}\left(n+\frac{1}{2}\right)$	$\hat{H}\phi_m = E_m\phi_m$
$\hat{H} = \hat{T} + \hat{V}(x)$	$m_e = 1\cdot 10^{-30} Kg$	$\omega_{os} = \sqrt{\frac{k_s}{\mu}}$	$\int_x \phi_n^* \phi_m dx = \delta_{m,n}$
$T = \frac{\hat{p}^2}{2m}$	$c = 3\cdot 10^8 m/\sec$	$\langle T\rangle_n = \langle V\rangle_n$	$1 = \int_x \Psi^*\Psi dx$
$\hat{p} = -i\hbar\frac{d}{dx}$	$N_A = 6\cdot 10^{23}\ {}^{molecules}/_{mole}$	$\int_{-\infty}^{\infty} e^{-\alpha x^2} dx = \sqrt{\frac{\pi}{\alpha}}$	$\langle A\rangle = \frac{\int_x \Psi^*\hat{A}\Psi dx}{\int_x \Psi^*\Psi dx}$
$e^{i\phi} = \cos\phi + i\sin\phi$	$E_n = \frac{1}{2m}\left(\frac{\hbar\pi n}{a}\right)^2$	$\int_{-\infty}^{\infty} x^2 e^{-\alpha x^2} dx = \frac{1}{2\alpha}\sqrt{\frac{\pi}{\alpha}}$	
$1 = \sin^2\phi + \cos^2\phi$	$V = \frac{q_1 q_2}{(4\pi\varepsilon_o) r}$	$E_J = \frac{\hbar^2}{2I} J(J+1)$	$i\hbar\frac{\partial}{\partial t}\Psi = \hat{H}\Psi$
$\sigma_x^2\sigma_x^2 \geq \left(\frac{\hbar}{2}\right)^2$	$E_n = -22\cdot 10^{-19}\left(\frac{Z}{n}\right)^2 J$		
$[p, x] = -i\hbar$			

There are 6 pages; with 8 (multi part) problems. Be sure you have all the pages before you start.
Be sure your name is on the exam before you start.
This is a timed 50 minute exam.
To receive full credit on all problems you must show your work or reasoning.

$\omega = ck$

$\lambda\nu = c$

$E = \hbar\omega = h\nu$

$E^2 = (cp)^2 + (mc^2)^2$

$p = \hbar k$

$[A, B+C] = [A, B] + [A, C]$

$[A, BC] = B[A, C] + [A, B]C$

An essay I may put on the final:
Q9) (P8.22) Explain (in a paragraph on this page) how the interaction of light can excite a molecule from one state to another. In your discussion explain how the frequency of light is related to the two states involved in the excitation, as well as the reason for the relation and be clear about the constraints on the two states that would allow absorption (i.e. selection rules). [Use of equations is not required but may help your discussion.]