DICIEMBRE 24

(1) C $\quad \lambda_e = \frac{h}{p} = \frac{h}{\sqrt{2mK}} \qquad \nu_e = \frac{v}{\lambda_e} = \frac{p}{m\lambda_e} = \frac{p^2}{mh} = \frac{2K}{h}$

x no dep t

D $\quad \frac{d\langle x\rangle}{dt} = \frac{d}{dt}\langle\Psi|x|\Psi\rangle = \langle\Psi|x\cdot\underbrace{\frac{d}{dt}|\Psi\rangle}_{=\frac{H}{i\hbar}|\Psi\rangle} + \underbrace{\frac{d}{dt}\langle\Psi|}_{=-\frac{H}{i\hbar}}\cdot x|\Psi\rangle = \frac{1}{i\hbar}\langle\Psi|xH - Hx|\Psi\rangle$

Si $\hat{H} = \frac{\hat{p}^2}{2m} + \hat{V}(x)$, $[x,\hat{H}] = \frac{2}{2m}\hat{p}[x,\hat{p}] = \frac{i\hbar\hat{p}}{m}$

↳ $\frac{d\langle x\rangle}{dt} = \frac{i\hbar}{i\hbar}\frac{1}{m}\langle\Psi|\hat{p}|\Psi\rangle = \frac{\langle\hat{p}\rangle}{m}$

$-i\hbar\,\partial_x(x f(x)) - f(x)\partial_x = -f'(x)\cdot$

E Análogamente $\frac{d}{dt}\langle\hat{p}\rangle = \frac{1}{i\hbar}\langle[\hat{p},H]\rangle = \frac{1}{i\hbar}\langle[\hat{p},\hat{V}(x)]\rangle = -\langle V'(x)\rangle$

F $\frac{d}{dt}\langle\hat{p}\rangle = -\langle\frac{dV}{dx}\rangle = a\langle x\rangle + 2ab\langle x^3\rangle$

$n=2 \quad l=0$

(2) D $\quad P(r\leq a_0) = \int_0^{a_0} r^2 dr\,|R(r)|^2 = \int_0^{a_0}\frac{1}{(2a_0)^3}\left(2-\frac{r}{a_0}\right)^2 r^2 e^{-\frac{r}{a_0}}dr = \ldots = 0{,}034$

↳ $P = 3{,}4\,\%$

$n=2 \quad l=1$

E r más probable: $0 = \frac{dP(r)}{dr} = \frac{d}{dr}\left(r^2|R(r)|^2\right) = \begin{cases} r=0 \leftarrow \text{mín} \\ r = 4a_0 \leftarrow \text{máx}\end{cases}$

F Cond extremo: $\frac{dP}{d\theta} = 0 = \frac{d}{d\theta}\left(\sin\theta\,|\Theta(\theta)|^2\right) = \frac{d}{d\theta}\left(\sin\theta - \sin^3\theta\right)$

$0 = \cos\theta\,(1 - 3\sin^2\theta) \longrightarrow \theta = \frac{\pi}{2}$ ó $\frac{3\pi}{2}$ mínimos

$x^2 = \frac{1}{3}$, $x = \pm\frac{1}{\sqrt{3}}$, $\theta = \arcsin\left(+\frac{1}{\sqrt{3}}\right)$ ó $\theta = \pi - \arcsin\frac{1}{\sqrt{3}}$