# $\boxed{\text{TAREA 7}}$

$\boxed{23}$

Lyman $\lambda_{2\to1} = 121.5\,nm$

Balmer $\lambda_{\infty\to2} = 364.6\,nm$

$$E = E_{2\to1} + E_{\infty\to2} \Rightarrow \frac{\cancel{hc}}{\lambda} = \frac{\cancel{hc}}{\lambda_{2\to1}} + \frac{\cancel{hc}}{\lambda_{\infty\to2}}$$

$$\lambda = \left(\frac{1}{\lambda_{2\to}} + \frac{1}{\lambda_{\infty\to2}}\right)^{-1} = \underline{91.13\,nm}$$

$\boxed{29}$

$$\left.\begin{aligned} n_i &= n+1 \\ n_f &= n \end{aligned}\right\} \quad \nu = -\frac{E_1}{h}\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right) \; ; \; f_n = -\frac{2E_1}{h}\left(\frac{1}{n^3}\right)$$

$$\Rightarrow \nu = \frac{-E_1}{h}\left(\frac{1}{n^2} - \frac{1}{(n+1)^2}\right) = \frac{-E_1}{h}\left(\frac{\cancel{n^2} + 2n + 1 - \cancel{n^2}}{n^2(n+1)^2}\right)$$

$$\nu = \frac{-2E_1}{h}\left(\frac{n + 1/2}{n^2(n+1)^2}\right)$$

Multiplicar $\frac{n}{n}$ en $\nu$.

$$\nu = \underbrace{\frac{-2E_1}{h}\left(\frac{1}{n^3}\right)}_{f_n}\left(\frac{n^2+n/2}{(n+1)^2}\right) = f_n\underbrace{\left(\frac{n^2+n/2}{(n+1)^2}\right)}_{<1} < f_n$$

Multiplicar $\frac{n+1}{n+1}$ en $\nu$.

$$\nu = \frac{-2E_1}{h}\left(\frac{1}{(n+1)^3}\right)\underbrace{\left(\frac{(n+1)(n+1/2)}{n^2}\right)}_{>1} > f_{n+1}$$

$$\boxed{f_{n+1} < \nu < f_n}$$

# $\boxed{\text{TAREA 8}}$

## $\boxed{14}$

$$\psi_n(x) = A \operatorname{sen}\left(\frac{n\pi x}{L}\right)$$

$$\psi_n(x) = A \operatorname{sen}\left(\frac{n\pi}{L}(x-x_0)\right)$$

Trasladamos $x_0$ unidades a la derecha

## $\boxed{23}$

Hint $\Rightarrow V=0$.

Tomar la ec. de Schrödinger

$$\nabla^2\psi + \frac{2m}{\hbar^2}(E-\underbrace{\cancel{V}}_{0})\psi = 0$$

Dada $\psi = A \operatorname{sen}\left(\frac{n_x\pi x}{L}\right) \operatorname{sen}\left(\frac{n_y\pi y}{L}\right) \operatorname{sen}\left(\frac{n_z\pi z}{L}\right)$

$$\frac{\partial^2 \psi}{\partial q_i^2} = -\frac{n_{q_i}^2 \pi^2}{L^2}\psi$$

$$-\frac{\pi^2}{L^2}\left(n_x^2+n_y^2+n_z^2\right)\psi + \frac{2mE}{\hbar^2}\psi = 0$$

$$\frac{2mE}{\hbar^2} = \frac{\pi^2}{L^2}\left(n_x^2+n_y^2+n_z^2\right)$$

a) $E(n_x, n_y, n_z) = \dfrac{\hbar^2 \pi^2}{2m}\left(n_x^2+n_y^2+n_z^2\right)$

b) $n_x = n_y = n_z = 1$

$$E_{min} = \frac{3\hbar^2 \pi^3}{2m}$$

$\boxed{\text{TAREA 9}}$

$\boxed{7}$

Teoría Cuántica $\quad L=\sqrt{\ell(\ell+1)}\,\hbar \quad , \ell=0,1,2,3,\dots$

$$\boxed{L=0}$$

Teoría de Bohr

$$L=n\hbar \qquad ; n=1,\dots$$

$$\boxed{L=\hbar}$$

$\boxed{17}$

$$R_{32}(r)=\frac{4}{81\sqrt{30}\,a_0^{3/2}}\,\frac{r^2}{a_0^2}\,e^{-r/3a_0}.$$

Necesitamos encontrar un máximo de $P(r)$

$$P(r)=r^6 e^{2r/3a_0} \Rightarrow \frac{dP(r)}{dr}=0 \rightarrow r=0 \ (\text{mult. } 5)$$

$$\rightarrow \boxed{r=9a_0}$$

# PARCIAL 5

19

$n_f = 1$

$n_o = 10$

Sabiendo $\frac{1}{\lambda} = R\left(1 - \frac{1}{100}\right)$

$$\lambda = \frac{100}{99R} = 92.047\,nm$$ 35/50

Ultravioleta 15/50

31

$$\langle x \rangle = \int_{-\infty}^{\infty} x\, \psi_n^* \psi_n \, dx \qquad \langle x^2 \rangle = \int_{-\infty}^{\infty} x^2 \psi_n^* \psi_n \, dx$$

$$\psi_0(x) = \left(\frac{2m\omega}{\hbar}\right)^{1/4} e^{-x^2/2}$$

$$\psi_1(x) = \left(\frac{2m\omega}{\hbar}\right)^{1/4} \sqrt{2}\, x\, e^{-x^2/2}$$

---

$\langle x \rangle_0 = 0 = \langle x \rangle_1$ 20/50

$$\langle x^2\rangle_0 = \left(\frac{2m\nu}{\hbar}\right)^{1/2}\int_{-\infty}^{\infty} x^2 e^{-x^2}\,dx = \left(\frac{2m\nu}{\hbar}\right)^{1/2}\frac{\sqrt{\pi}}{2}$$

30/50

$$\langle x^2\rangle_1 = 2\left(\frac{2m\nu}{\hbar}\right)^{1/2}\underbrace{\int_{-\infty}^{\infty} x^4 e^{-x^2}\,dx}_{\frac{3\sqrt{\pi}}{4}} = \frac{3\sqrt{\pi}}{2}\left(\frac{2m\nu}{\hbar}\right)^{1/2}$$