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1.

2. Para comenzar hagamos recuento del teorema de Ehrenfest el cual dice

$$\frac{d < A >}{dt} = \frac{i}{h}\left\langle [\hat{H}, \hat{A}] \right\rangle + \left\langle \frac{\partial \hat{A}}{\partial t} \right\rangle. \tag{1}$$

Y dado que partimos desde

$$\frac{d < xp >}{dt}.$$

Ahora bien, tomemos también en cuenta que

$$[\hat{A}, \hat{B}\hat{C}] = [\hat{A}, \hat{B}]\hat{C} + [\hat{A}, \hat{C}]\hat{B} \tag{2}$$

$$[f(\hat{A}), \hat{B}] = \frac{\partial f}{\partial A}[\hat{A}, \hat{B}] \tag{3}$$

$$\hat{K} = \frac{\hat{P}}{2m} \tag{4}$$

$$\hat{p} = \frac{-\hbar}{i}\frac{\partial}{\partial x} \tag{5}$$

Ahora bien, con todo esto partamos el desarrollo

$$
\begin{aligned}
\frac{d < xp >}{dt} &= \frac{i}{\hbar} \left\langle [\hat{H}, xp] \right\rangle + \left\langle \frac{\partial xp}{\partial t} \right\rangle \\
&= \frac{i}{\hbar} \left\langle [\hat{H}, x]p + [\hat{H}, p]x \right\rangle + \left\langle p\frac{\partial x}{\partial t} + x\frac{\partial p}{\partial t} \right\rangle \\
\frac{\partial p}{\partial t} &= 0 \\
\frac{\partial x}{\partial t} &= V \\
&= \frac{i}{\hbar} \left\langle [\hat{H}, x]p + [\hat{H}, p]x \right\rangle + \langle pV \rangle \\
&= \frac{i}{\hbar} \left\langle [\hat{H}, x]p + [\hat{H}, p]x \right\rangle - \frac{i}{\hbar} \left\langle \frac{\partial v}{\partial x} \right\rangle \\
[\hat{H}, x]f &= \hat{H}\hat{x} - \hat{x}\hat{H} \\
&= \left(\frac{\hat{p}^2}{2m} + \hat{V} \right) \hat{x}f - \hat{x} \left(\frac{\hat{p}^2}{2m} + \hat{v} \right) f \\
&= \left(\frac{1}{2m} \left(-i\hbar\frac{\partial}{\partial x} \right)^2 \hat{x}f + \hat{V}\hat{x}f \right) - \hat{x} \left(\frac{1}{2m} \left(-i\hbar\frac{\partial}{\partial x} \right) f + \hat{V}f \right) \\
&= \left(\frac{1}{2m} \left(\hbar^2\frac{\partial^2}{\partial x^2} \right) \hat{x}f + \hat{V}\hat{x}f \right) - \hat{x} \left(\frac{1}{2m} \left(\hbar^2\frac{\partial^2}{\partial x^2} \right) f + \hat{V}f \right) \\
&.
\end{aligned}
$$

1.

$$\hat{H} = \begin{pmatrix} a & 0 & b \\ 0 & c & 0 \\ b & 0 & a \end{pmatrix} ; \quad a, b, c \in R$$

Encontrar Valores y Vectores propios

$$\hat{H} - \lambda I = \begin{pmatrix} a-\lambda & 0 & b \\ 0 & c-\lambda & 0 \\ b & 0 & a-\lambda \end{pmatrix}$$

$$\det(H - \lambda I) = (a-\lambda)((c-\lambda)(a-\lambda)) + b(-((c-\lambda)\cdot b))$$

$$= (a-\lambda)^2 (c-\lambda) - b^2 (c-\lambda)$$

$$= (c-\lambda)((a-\lambda)^2 - b^2)$$

$$= \quad ((\quad$$

$$\lambda = c \;;\; \lambda = a-b \;;\; \lambda = a-b$$

$$\begin{pmatrix} a-c & 0 & b \\ 0 & 0 & 0 \\ b & 0 & a-\lambda \end{pmatrix} ; \quad \begin{aligned} (a-c)x_1 + b\,x_3 &= 0 \\ b\,x_1 + (a-\lambda)x_3 &= 0 \end{aligned}$$

$$a - \lambda = b$$

$$\lambda = a - b$$