$$\langle p_x(t)\rangle = \langle \psi(t)|\,\hat{p}_x\,|\psi(t)\rangle$$

$$= \frac{1}{3}\langle \varphi_0|\,\hat{p}_x\,|\varphi_0\rangle + \frac{2}{3}\langle \varphi_1|\,\hat{p}_x\,|\varphi_1\rangle$$

$$+ 2\,\frac{\sqrt{2}}{3}\,\mathrm{Im}\left(e^{\frac{i}{\hbar}(\varepsilon_1-\varepsilon_0)t}\,\langle \varphi_1|\,\hat{p}_x\,|\varphi_0\rangle\right)$$

<u>Usando</u>: $\langle n'|\,\hat{p}_x\,|n\rangle = i\sqrt{\frac{m\hbar\Omega}{2}}\left(\sqrt{n+1}\,\delta_{n',n+1} - \sqrt{n}\,\delta_{n',n-1}\right)$

se tiene:

$$\langle \varphi_0|\,\hat{p}_x\,|\varphi_0\rangle = \langle \varphi_1|\,\hat{p}_x\,|\varphi_1\rangle = 0$$

$$\langle \varphi_1|\,\hat{p}_x\,|\varphi_0\rangle = i\sqrt{\frac{m\hbar\Omega}{2}}\cdot\sqrt{2} = i\sqrt{m\hbar\Omega}$$

de donde:

$$\langle p_x(t)\rangle = 2\,\frac{\sqrt{2}}{3}\cdot\sqrt{m\hbar\Omega}\cdot\mathrm{Im}\left(i\,e^{i\Omega t}\right)$$

$$= \frac{2\sqrt{2}}{3}\sqrt{m\hbar\Omega}\,\cos(\Omega t)$$