Matrix mechanics 5

Let Ω be the following time translation matrix.

$$\Omega = \frac{1}{\hbar} H$$

where

$$H = \frac{1}{2m}\left({P_1}^2 + {P_2}^2 + {P_3}^2\right)$$

Let U be the unitary transformation

$$U = 1 - i\epsilon\Omega - \tfrac{1}{2}\epsilon^2\Omega^2$$

1. Show that to order ϵ^2

$$U^{-1}X_1U = X_1 + \frac{\epsilon}{m}P_1$$
$$U^{-1}X_2U = X_2 + \frac{\epsilon}{m}P_2$$
$$U^{-1}X_3U = X_3 + \frac{\epsilon}{m}P_3$$

2. Show that to order ϵ^2

$$U^{-1}P_1U = P_1$$
$$U^{-1}P_2U = P_2$$
$$U^{-1}P_3U = P_3$$

3. Show that to order ϵ^2

$$U^{-1}L_1U = L_1$$
$$U^{-1}L_2U = L_2$$
$$U^{-1}L_3U = L_3$$

4. Show that to order ϵ^2

$$U^{-1}HU = H$$