UNIVERSITY OF CALIFORNIA, SANTA BARBARA
Department of Physics

Physics 115A
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Midterm (continued)

2. Continued... The next parts are for $t$ not equal to 0:

(h) What is $\psi(x,t)$ for this state?

Solutions of full Sch. equation are $u_n(x)\, e^{-\frac{i}{\hbar}E_n t}$

$\psi(x,t) = \sum_n C_n u_n(x)\, e^{-\frac{i}{\hbar}E_n t}$, at $t=0$

$C_1 = \frac{1}{\sqrt{2}}$, $C_3 = \frac{1}{\sqrt{2}}$ all other $C_n$'s $= 0$

so $\psi(x,t) = \frac{1}{\sqrt{2}}\left[u_1(x)\, e^{-\frac{i}{\hbar}E_1 t} + u_3(x)\, e^{-\frac{i}{\hbar}E_3 t}\right]$

$= \frac{1}{\sqrt{2}}\left[u_1(x)\, e^{-\frac{i\hbar}{2m}\left(\frac{\pi}{a}\right)^2 t} + u_3(x)\, e^{-\frac{i\hbar}{2m}\left(3\frac{\pi}{a}\right)^2 t}\right]$

(i) Is $\langle p \rangle$ a constant in time?

$$\langle p \rangle = \int_0^a \psi^*(x,t)\left(-i\hbar\right)\frac{d\psi(x,t)}{dx}\, dx.$$

These are the same integrals as part (f), so $\langle p \rangle = 0$.