Spring 2002 # 3

a) If $AB+BA=0$, it is not possible for them to have simultaneous eigenkets

$A|\psi\rangle = a|\psi\rangle \quad B|\psi\rangle = b|\psi\rangle$

Then $AB|\psi\rangle = Ab|\psi\rangle = ab|\psi\rangle$ eigenvalues commute

$BA|\psi\rangle = Ba|\psi\rangle = ab|\psi\rangle$

$\Rightarrow (BA+AB)|\psi\rangle = 2ab|\psi\rangle = 0 \Rightarrow$ a or b must be zero.

b) no. For example, a free particle

$x(t) = x(0) + v(0)t$

$= x(0) + \frac{p(0)}{m}t$

$[x(t), x(0)] \neq 0$

c) Δt is the time it takes for the system to change substantially.

$\Psi(x,t) = a\psi_1(x)e^{-iE_1t/\hbar} + b\psi_2(x)e^{-iE_2t/\hbar}$

$|\psi(x,t)|^2 = a^2(\psi_1(x))^2 + b^2(\psi_2(x))^2 + 2ab\psi_1\psi_2\cos\left(\frac{E_2-E_1}{\hbar}t\right)$

$\Rightarrow$ period is $\frac{2\pi\hbar}{(E_2-E_1)} = T \Rightarrow \Delta T \Delta E = 2\pi\hbar > \hbar/2$ Griffith pg 114