PHY 341 HW Ch.2b

Do problems 2.6, plus the following:

q2-5 Regarding a well-behaved but otherwise arbitrary wave function $\Psi(x,t)$, (a) Is it always normalizable? Write it down. (b) Now ask an AI bot like ChatGPT, DeepSeek or Gemini (maybe even all 3 plus some other bot you like) the same question, critique and compare its answer with yours.

q2-6
Consider a particle in the box with the initial wave function $\Psi(x,0)$, which is normalized but otherwise arbitrary except $\Psi(0,0) = \Psi(a,0) = 0$.
(a) If you expand it in terms of the complete basis set $\psi_n(x)$ to obtain the expansion coefficients c_n, what is the meaning of c_n? Does $|c_n|^2 = c_n^2$ always hold?
(b) Imagine one squeezes the box slowly so its width a is reduced by half. During the process, what would happen to (i) the wave function at the walls, (ii) the value $\int |\Psi|^2 dx$, and (iii) the final $\langle x \rangle$ and $\langle H \rangle$? Explain.

q2-7
The wave function at $t = 0$ is $\Psi(x,0) = \sum_{n=0}^{n=10} c_n \psi_n(x)$, where c_n are nonzero constants and ψ_n the stationary states of the infinite potential well. At later times t, which of the following is *independent* of time? Answer each as true or false, and briefly state reason.
(a) position, $\langle x \rangle$

(b) momentum, $\langle p \rangle$

(c) momentum squared, $\langle p^2 \rangle$

(d) energy, $\langle E \rangle$

(e) potential energy, $\langle V \rangle$

(f) kinetic energy, $\langle T \rangle$