(10)

$$\psi(a) = \int_{-\infty}^{\infty} \left(\frac{a^2}{\pi}\right)^{1/4} \exp\left(\frac{-k^2 a^2}{2}\right) \frac{1}{\sqrt{2\pi}} \exp(ik(x-b))\, dk$$

from which we can identify the quantum amplitude, $a(k)$ of the Fourier transform.

$$a(k) = \left(\frac{a^2}{\pi}\right)^{1/4} \exp\left(\frac{-k^2 a^2}{2}\right) \exp(-ikb)$$ ✓

Then using eq. 26b, p 235 unit 11

$$P(p_x; \psi; \Delta p_x) = \int_{(p_x - \frac{\Delta p_x}{2})/\hbar}^{(p_x + \frac{\Delta p_x}{2})/\hbar} |a(k)|^2 dk$$

$$\frac{1}{\hbar} \int_{(p_x - \frac{\Delta p_x}{2})/\hbar}^{(p_x + \frac{\Delta p_x}{2})/\hbar} |a(p_x/\hbar)|^2 dp_x$$

$$\simeq \frac{1}{\hbar} |a(p_x/\hbar)|^2 \Delta p_x$$ since Δp_x is small, $|a(p_x/\hbar)|$ is roughly constant in $\left(p_x - \frac{\Delta p_x}{2}, p_x + \frac{\Delta p_x}{2}\right)$

$$= \frac{1}{\hbar} \left|\left(\frac{a^2}{\pi}\right)^{1/4} \exp\left(\frac{p_x^2 a^2}{2\hbar^2}\right) \exp(ikb)\right|^2 \Delta p_x$$

minus sign missing!

$$= \frac{1}{\hbar} \left|\frac{a}{\sqrt{\pi}} \exp\left(\frac{p_x^2 a^2}{\hbar^2}\right)\right| \Delta p_x$$

$$= \frac{a}{\hbar\sqrt{\pi}} \exp\left(\frac{p_x^2 a^2}{\hbar^2}\right) \Delta p_x$$

4/5

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(PS (The integral * can be solved exactly. It is $\frac{1}{a}\left(\mathrm{erf}\left(a\left(k + \frac{\Delta k}{2}\right)\right) - \mathrm{erf}\left(a\left(k - \frac{\Delta k}{2}\right)\right)\right)$ ✓

6.i) This statement is wrong. The effect of an act of measurement is to force a the measured quantity to take on a value. For the energy of the SHM for example, the effect is to force the SHM into an eigenstate with associated eigenvalue. If before the measurement, the wavefunction of the particle consisted of a super position of eigenstates with various quantum amplitudes, after the measurement the particle will exist in the eigenstate associated with the energy measured; subsequent measurements will confirm this.

For continuous quantities such as position or momentum, with badly behaved operators, measurement is associated

PTO

This is not relevant