

#1)

Let $P_{ab}(t)$ be the probability of finding a particle in the range $(a < x < b)$, at time t .

[A] Show that $\frac{dP_{ab}}{dt} = J(a, t) - J(b, t)$,

$$\text{where } J(x, t) \equiv \frac{i\hbar}{2m} \left(\psi \frac{\partial \psi^*}{\partial x} - \psi^* \frac{\partial \psi}{\partial x} \right).$$

What are the units of $J(x, t)$?

[B] Find the probability current for the wave function $\rightarrow \psi(x, t) = A e^{-a \left[\left(\frac{mx^2}{\hbar} \right) + it \right]}$

#2) Compute commutator $[x^2, p], [x^3, p]$.

Can you first, guess, and then prove, using, for instance, the method of mathematical induction, the formula for ?