Homework 05

Problem 1

Use $[a, a^\dagger] = 1$, arrange operator $A = aa^\dagger a^\dagger aa^\dagger$ into a form so that $\hat{a}^\dagger$ are all on the left, and $\hat{a}$ are all on the right, for example $a^\dagger a^\dagger a^\dagger aa + 2a^\dagger a$, etc. Before arranging, A has three $a^\dagger$ and two a. Does this still hold after arranging?

Problem 2

Evaluate $[a, A]$, $A = aa^\dagger a^\dagger a$.

Problem 3

For a fork state $|n\rangle$, calculate $\langle \Delta x^2 \rangle$, $\langle \Delta p^2 \rangle$, and does it obey uncertainty principle?

Problem 4

$\xi(\lambda) = e^{i\lambda a^\dagger a} a e^{-i\lambda a^\dagger a}$, λ is a number

1. Evaluate $\xi'(\lambda)$

2. Get a differential equation in the form $\xi'(\lambda) = c\xi(\lambda)$, and obtain $\xi(\lambda)$