

**Worksheet #4**

(Monday, January 12, 2026)

**Name**

**Questions (5 pts):**

Consider the number operator  $N = a^\dagger a$ , where  $a^\dagger$  and  $a$  are creation and annihilation operators, respectively.

(a) Is  $a^\dagger a = a a^\dagger$ ? In other words, find the commutator  $[a, a^\dagger]$

(b) Using the result of (a), express  $a a^\dagger$  in terms of the number operator  $N$

- (c) Find the relationship between the Hamiltonian of the 1D harmonic oscillator and the number operator.