Midterm Exam (part 1) - Quantum Mechanics I

NAME: _____ **SCORE:**

Date: Tuesday 14 October 2025 **Duration:** 45 minutes

Credits: 10 points (4 questions) **Type of evaluation:** MT

I) Please provide concise answers to the following items:

1. **(2.5 points) Light duality**

   a. Describe 2 distinct experiments that demonstrated the wave–particle duality of light.

   b. For each experiment, briefly explain what aspect of light (wave or particle) it revealed.

2. **(2.5 points) Finite potential well analysis**

   a. Explain qualitatively how the wave function behaves inside and outside a finite potential well for a bound state.

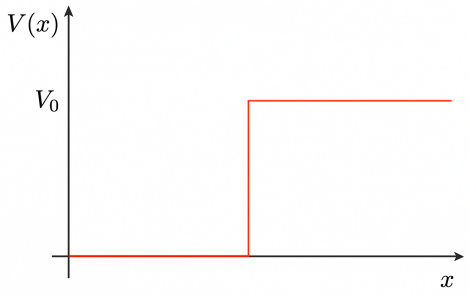
   b. Explain qualitatively how a particle can penetrate and pass through a potential barrier even when its energy is less than the barrier height.

3. **(2.5 points) Quantum Harmonic Oscillator**

a. Explain the role of the raising and lowering (ladder) operators in the quantum harmonic oscillator.

b. Explain how the energy levels of the quantum harmonic oscillator differ from those of a classical harmonic oscillator.

4. **(2.5 points) Reflection and transmission at a step potential**



Imagine a particle moves from left to right in a step potential (see figure). Qualitatively:

a. Describe what happens to a particle incident on the potential step when its energy is (i) greater than the step height (V_0) and (ii) less than the step height.

b. Explain how the reflection coefficient R and transmission coefficient T would behave in each case.