# Exercises

**Exercise 1: Apply Basic Quantum Gates**

1. Create a quantum circuit with one qubit and one classical bit.
2. Apply the following gates in sequence:
    - **Hadamard gate** on the qubit.
    - **Pauli-X gate** on the same qubit.
3. Measure the qubit and store the result in the classical bit.
4. Visualize the circuit and execute it on a simulator.

**Exercise 2: Create a Bell State**

1. Build a circuit with two qubits and two classical bits.
2. Initialize both qubits in the ground state.
3. Apply the following gates:
    - **Hadamard gate** on the first qubit.
    - **CNOT gate** with the first qubit as control and the second qubit as target.
4. Measure both qubits and store the results.
5. Visualize the statevector or measurement outcomes.

**Exercise 3: Apply Single-Qubit Gates**

1. Create a single-qubit circuit.
2. Apply the following gates sequentially:
    - **Pauli-X**
    - **Pauli-Y**
    - **Pauli-Z**
    - **Hadamard**

3. Print the final statevector.

**Exercise 4: Controlled Gates**

1. Create a 3-qubit circuit.
2. Apply a **Toffoli (CCX)** gate with the first two qubits as controls and the third as the target.
3. Simulate and display the final statevector.

**Exercise 5: Phase Kickback**

1. Build a 2-qubit circuit.
2. Use a Hadamard gate on the first qubit and a **controlled-Z** gate between the qubits.
3. Observe the phase kickback effect in the statevector.