HOMEWORK 11

QUANTUM MECHANICS 2

1. Which of the following properties of an electron is measured in the Stern-Gerlach experiment?

   a) Charge

   b) Kinetic Energy

   c) Mass

   d) Spin

2. After passing through a Stern-Gerlach apparatus, how many possible values for electron spin can be measured?

   a) 1

   b) 2

   c) 4

   d) A continuous range of values can be measured

3. The orientation of the Stern-Gerlach apparatus corresponds to which of the following?

   a) The **basis** of measurement of electron spin.

   b) The **energy range** of measurement of electron spin

   c) The possible values for **magnitude** of electron spin that can be measured.

   d) Orientation of the Stern-Gerlach apparatus does not matter.

For **Questions 4-6**, state whether the following statements are **True** or **False**

4. A quantum state is changed when it is measured.

5. The probability of measuring a given quantum state does **not** depend on the **basis of measurement**

6. Electron spin is an example of a **single level system**

Questions 7-12 will use a sketch of the results of Stern-Gerlach experiments. A Stern-Gerlach apparatus oriented in the **z**-direction is represented by a box and the output of the apparatus corresponds to electrons which have been measured in the $|0\rangle$ state and $|1\rangle$ state. For example, an initial electron beam going through a Stern-Gerlach apparatus oriented in the z-direction, which results in 50% of electrons being measured as $|0\rangle$ and 50% being measured as $|1\rangle$ would be illustrated as follows.
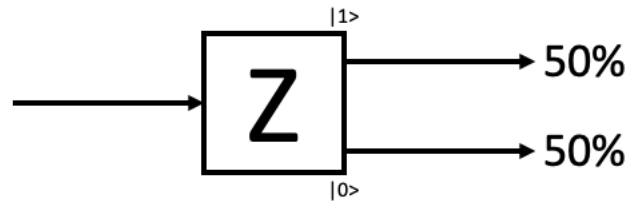

Similarly, an initial electron beam passing through a Stern-Gerlach apparatus oriented in the **x**-direction with outputs of $|+\rangle$ and $|-\rangle$ would be illustrated as:
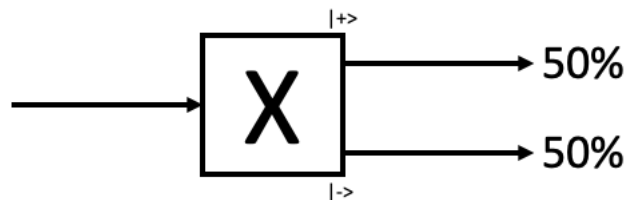

In **Questions 7-12** we will analyze how various combinations of Stern-Gerlach measurements affect an initial electron beam. Answers to these questions should be given as a **percent of the initial number of electrons** that will travel down the given branch in the experiment.

Use the following Stern-Gerlach configuration to answer **Questions 7 & 8**.
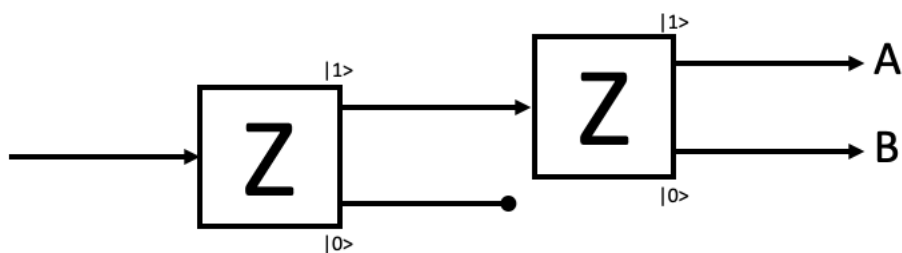
7. What percent of the initial number of electrons will travel down branch **A**?

    a) 0%

    b) 25%

    c) 50%

    d) 100%

8. What percent of the initial number of electrons will travel down branch **B**?

    a) 0%

    b) 25%

    c) 50%

    d) 100%

Use the following Stern-Gerlach configuration to answer **Questions 9 & 10**.
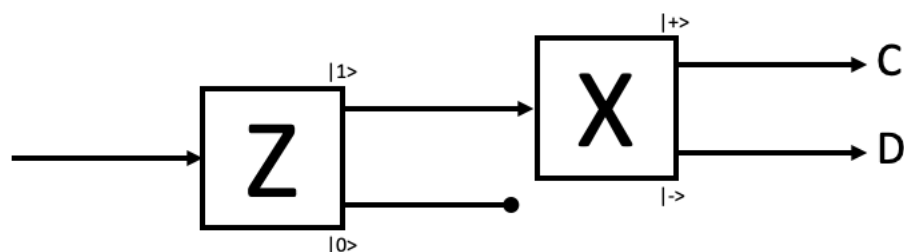
9. What percent of the initial number of electrons will travel down branch **C**?

    a) 0%

    b) 25%

    c) 50%

    d) 100%

10. What percent of the initial number of electrons will travel down branch **D**?

    a) 0%

    b) 25%

    c) 50%

    d) 100%

Use the following Stern-Gerlach configuration to answer **Questions 11 & 12**.
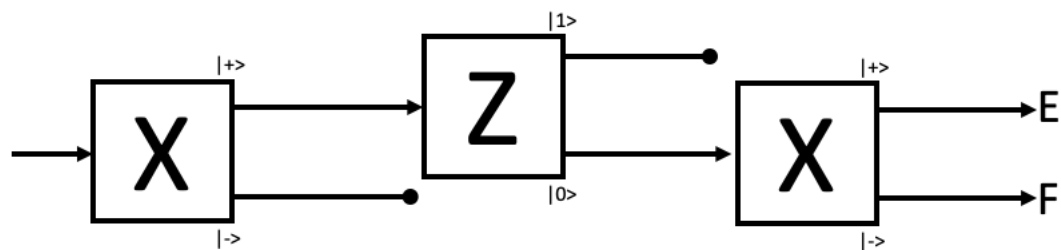
11. What percent of the initial number of electrons will travel down branch **E**?

    a) 0%
    b) 12.5%
    c) 25%
    d) 50%

12. What percent of the initial number of electrons will travel down branch **F**?

    a) 0%
    b) 12.5%
    c) 25%
    d) 50%