

# Mathematics of Probability / Superposition and Measurement Homework Questions

1. Sandra and Ayesha are playing a board game. They are playing with 1 standard 6-sided die.
  - a. Sandra needs to move her piece 4 spaces to win the game. She must roll exactly 4 to win in this round.
    - i. What is the probability that Sandra will roll a 4 and win? ( $\frac{1}{6}$  or 0.167)
    - ii. What is the probability that Sandra will not roll a 4? ( $\frac{5}{6}$  or 0.833)
  - b. If Ayesha rolls exactly 6, she has to go back to the start of the game.
    - i. What is the probability that Ayesha will roll a 6 and have to go back to the start? ( $\frac{1}{6}$  or 0.167)
    - ii. What is the probability that Ayesha will not roll a 6? ( $\frac{5}{6}$  or 0.833)
  - c. What is the probability that Sandra will **not** win and Ayesha will **go back to the start** of the game? ( $\frac{5}{6} * \frac{1}{6} = 0.139$ )
  - d. What is the probability that Sandra will win and Ayesha will **not go back to the start** of the game? ( $\frac{1}{6} * \frac{5}{6} = 0.139$ )
  - e. What is the most likely outcome of this round?
    - i. Sandra wins, Ayesha goes back to the start
    - ii. Sandra does not win, Ayesha goes back to the start
    - iii. Sandra wins, Ayesha does not go back to the start
    - iv. Sandra does not win, Ayesha does not go back to the start (correct answer,  $\frac{25}{36}$  or 0.694)
2. Avion has a bag of candies. He counted the number of candies of each color and found that his bag is 24% blue, 20% orange, 16% green, 15% yellow, 14% red, and 13% brown.
  - a. If he picks one candy from the bag, which color is he most likely to choose?
    - i. Blue (correct)
    - ii. Orange
    - iii. Green
    - iv. Yellow
    - v. Red
    - vi. Brown
  - b. If he picks one candy from the bag, which color is he least likely to choose?
    - i. Blue
    - ii. Orange
    - iii. Green
    - iv. Yellow
    - v. Red
    - vi. Brown (correct)

A qubit is a superposition of how many values?

- a) 0
- b) 1
- c) 2
- d) unknown until measurement occurs

What information is held in the quantum state?

- a) each possible outcome after measurement
- b) phase
- c) the probability of measuring one outcome over another
- d) all of the above

Select all possible values of a qubit after measurement.

- a) 0
- b) 1
- c) a superposition of  $|0\rangle$  or  $|1\rangle$

Quantum operations can be used to change the \_\_\_\_\_ of measuring one outcome over another.

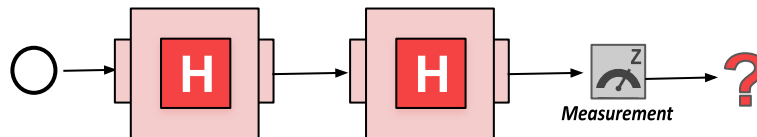
- a) superposition
- b) probability
- c) phase
- d) qubit



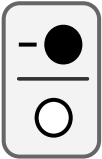
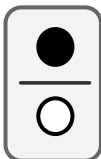


The utensil above is an example of an object in a state of superposition. (true / false)

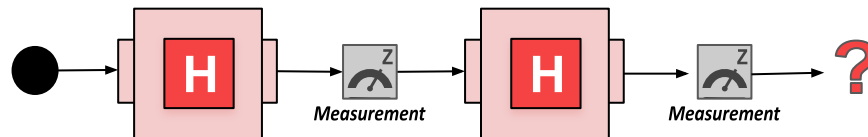
I think this because, \_\_\_\_\_ .

- a) It can be measured with a ruler
- b) It is a combination of both a spoon and a knife
- c) It makes a much better spoon than knife
- d) I don't have any information about the phase

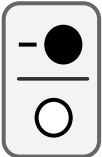
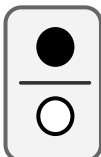




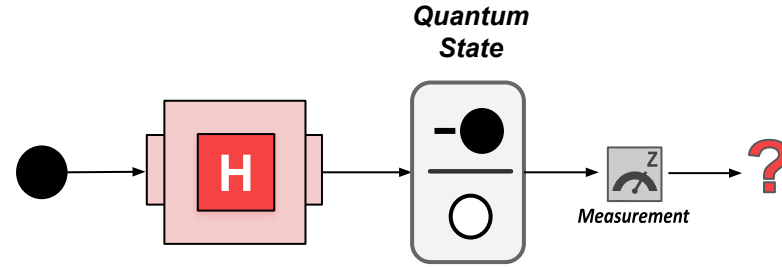
The outcome of this circuit will be:

- A.**  **B.**  **C.**  **D.**  **E.** The outcome cannot be determined



The outcome of this circuit will be:

- A. 
- B. 
- C. 
- D. 
- E. The outcome cannot be determined



What information held in the quantum state shown above is lost by the act of measurement? Select all that apply.

- a) information about phase
- b) the original input value
- c) information about probability
- d) the ancilla bit



Consider the following act of measurement:

Taking someone's temperature 

What is the measurement device?

- a) The person's forehead
- b) An infrared thermometer
- c) The person's temperature
- d) No measurement occurred

This method of measurement changes the state of the object being measured.

(true / false)