

# Sample question from ACEPhysics activity:



## $X$ gate (Also called “Not gate” or $U_{Not}$ gate)

The  $X$  gate performs the function of a NOT gate, changing  $|0\rangle$  to  $|1\rangle$  and vice versa.

The mathematical expression that matches this sentence is  $X|0\rangle = |1\rangle$ .

Mathematically, the  $X$  gate is written in matrix notation as

$$X = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$$

Take a moment to verify (using matrix multiplication) that

$$X|0\rangle = |1\rangle \quad \text{and} \quad X|1\rangle = |0\rangle.$$

I verified these equalities ↓

A. What is  $X(a|0\rangle + b|1\rangle)$ ?



Type your response here

Can you answer this without using matrices?