# PHYS 234: Quantum Physics 1 (Winter 2026)
## Quiz 2

Let $|\pm\rangle$ denote the $S_z$ eigenstates for a spin-1/2 particles. Given the vector

$$|\psi\rangle = \frac{e^{i\theta}}{\sqrt{2}}\left(|+\rangle + e^{i\varphi}\,|-\rangle\right), \qquad \theta, \varphi \in \mathbb{R}$$

which of the following statements is true? Justify your answer.

1. $|\psi\rangle$ is not a physically-valid state, since it is not normalized.

2. For arbitrary $\varphi$, $|\psi\rangle$ is an eigenstate of the $S_x$ operator.

3. The probabilities of measuring different values of $S_x$ is independent of $\varphi$.

4. The probabilities of measuring different values of $S_x$ is independent of $\theta$.

   *Hint:* Recall that the $S_x$ eigenstates are $|\pm\rangle_x = (|+\rangle \pm |-\rangle)/\sqrt{2}$.