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

Given the vectors

$$u = \frac{1}{\sqrt{2}} \begin{pmatrix} 1 \\ 1 \end{pmatrix}, \qquad v = \frac{1}{\sqrt{2}} \begin{pmatrix} 1 \\ e^{i\theta} \end{pmatrix},$$

where $\theta \in \mathbb{R}$, calculate the modulus squared of their inner product, i.e. $|\langle v|u\rangle|^2$. Simplify your result in terms of a real trigonometric function.

Hint: Recall that

$$e^{i\theta} = \cos\theta + i\sin\theta \quad \text{(Euler's formula)}$$

$$\cos^2\left(\frac{\theta}{2}\right) = \frac{1+\cos\theta}{2} \quad \text{(Double angle formula)}$$