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

$$\begin{aligned}
|\langle v|u\rangle|^2 &= \left| \frac{1}{\sqrt{2}} \begin{pmatrix} 1 & e^{i\theta} \end{pmatrix}^* \frac{1}{\sqrt{2}} \begin{pmatrix} 1 \\ 1 \end{pmatrix} \right|^2 \\
&= \frac{1}{4} \left| 1 + e^{-i\theta} \right|^2 \\
&= \frac{1}{4} (1 + e^{-i\theta})^* (1 + e^{-i\theta}) \\
&= \frac{1}{4} (1 + 1 + e^{-i\theta} + e^{i\theta}) \\
&= \frac{1}{4} (2 + \cos\theta - i\sin\theta + \cos\theta + i\sin\theta) \\
&= \frac{1}{2} (1 + \cos\theta) \\
&= \boxed{\cos^2\left(\frac{\theta}{2}\right).}
\end{aligned}$$