Test 1

Problem t1

Is it possible to prepare a pure state of spin 1/2 particles for which

$$\textbf{(a)}\ |\langle S_{\mathbf{x}}\rangle| > \Delta S_{\mathbf{y}}\,? \qquad \textbf{(b)}\ |\langle S_{\mathbf{x}}\rangle| = \Delta S_{\mathbf{y}}\,?$$

If you answer *yes*, provide an example of the Bloch vector specifying the state. If you answer *no*, explain why not.

Problem t2

Find the angle α $(0 \le \alpha \le \pi)$ between the Bloch vectors corresponding to the spin 1/2 state vectors

$$|\psi_1\rangle = \cos(\pi/8)\,|+\mathbf{n}\rangle + e^{i\pi/4}\sin(\pi/8)\,|-\mathbf{n}\rangle, \quad |\psi_2\rangle = e^{i\pi/4}\cos(\pi/8)\,|+\mathbf{n}\rangle + \sin(\pi/8)\,|-\mathbf{n}\rangle.$$

You may find useful the trigonometric identities $1+\cos(2\theta) = 2\cos^2\theta$, $1-\cos(2\theta) = 2\sin^2\theta$.