HL SL

Find the value of x for which the vectors $\begin{pmatrix} \sin x \\ \sqrt{3} \\ 0 \end{pmatrix}$ and $\begin{pmatrix} 4\cos x \\ -1 \\ 2 \end{pmatrix}$ are perpendicular, $0 \leq x \leq \frac{\pi}{2}$.

Vectors are perpendicular means scalar product = 0

$$\begin{pmatrix} \sin x \\ \sqrt{3} \\ 0 \end{pmatrix} \cdot \begin{pmatrix} 4\cos x \\ -1 \\ 2 \end{pmatrix} = 0$$

$$4\sin x \cos x - \sqrt{3} = 0$$

$$2(2\sin x \cos x) - \sqrt{3} = 0 \qquad \sin 2x = 2\sin x \cos x$$

$$2\sin 2x - \sqrt{3} = 0$$

$$2\sin 2x = \sqrt{3}$$

$$\sin 2x = \frac{\sqrt{3}}{2}$$

$$2x = \frac{\pi}{3} \qquad \sin\frac{\pi}{3} = \frac{\sqrt{3}}{2}$$

$$x = \frac{\pi}{6}$$