Four polarizers are set up so that the transmission axis of each successive filter is rotated clockwise by an angle $\Theta$ relative to the previous polarizer. Find the angle $\Theta$ for which unpolarized light is transmitted through these four polarizers with its intensity reduced by a factor of 25.

Initially unpolarized light $\quad I = \frac{1}{2} I_0$

Initially polarized light $\quad I = I_0 \cos^3 \Theta$

* After light passes through a polarizing filter, it is now polarized in the direction of the filter.

$I_1 = \frac{1}{2} I_0$

$I_2 = I_1 \cos^2 \Theta = \left(\frac{1}{2} I_0\right) \cos^3 \Theta$

$I_3 = I_2 \cos^2 \Theta = \frac{1}{2} I_0 \cos^4 \Theta$

$I_4 = I_3 \cos^2 \Theta = \frac{1}{2} I_0 \cos^6 \Theta$

$I_4 = \frac{1}{25} I_0 \quad \rightarrow \quad \frac{1}{2} I_0 \cos^6 \Theta = \frac{1}{25} I_0$

$\frac{1}{2} \cos^6 \Theta = \frac{1}{25} \quad \rightarrow \quad \cos^6 \Theta = \frac{3}{25}$

$\cos \Theta = \left(\frac{3}{25}\right)^{\frac{1}{6}} \quad \rightarrow \quad \Theta = \cos^{-1} \left(\frac{3}{25}\right)^{\frac{1}{6}}$

$\Theta = 49^\circ$