

CLASS EXERCISE #22 - 27 July 2005

Initially unpolarized light passes through four different polarizers, all of them letting through light polarized in a horizontal plane (like polarizers sitting on an overhead projector). The first lets through light polarized in the $+x$ direction, the second light polarized in the direction $\theta = 45^\circ$ (measured, as always, counterclockwise from the $+x$ axis), the third light polarized in the $+y$ direction, and the fourth light polarized in the direction $\theta = 150^\circ$.

Determine the fraction of the initial light (call its intensity 100%) that passes through each of these four polarizers in turn. (The fraction continually decreases, or possibly remains the same.)

The angles of the four polarizers are, respectively, 0° , 45° , 90° , and 150° .

Initially: 100%, randomly polarized

Through #1: 50%, now along $+x$ (0°)

Through #2: $(50\%) \cos^2(45^\circ - 0^\circ) = (50\%)(0.50) = 25\%$

Through #3: $(25\%) \cos^2(90^\circ - 45^\circ) = (25\%)(0.50) = 12.5\%$

Through #4: $(12.5\%) \cos^2(150^\circ - 90^\circ) = (12.5\%)(0.25) = 3.125\%$