Solution Assignment 4: (Spring 2012) Physics

PHYSICS (PHY101)
TOTAL MARKS: 20
Due Date: 27/06/2012

Question # 1

What is the angle of refraction here, shown in above fig?  

Marks = 5

Solution

$n_{\text{air}} = 1.00$
$n_{\text{glass}} = 1.52$
$\theta_i = 30^\circ$

Find
$\theta_r = ?$

$n_{\text{air}} \sin \theta_i = n_{\text{glass}} \sin \theta_r$

$$\frac{\sin \theta_r}{\sin \theta_i} = \frac{n_{\text{air}}}{n_{\text{glass}}}$$

$$\sin \theta_r = \sin 30^\circ \frac{n_{\text{air}}}{n_{\text{glass}}}$$

$$= (0.5)(1)$$

$$= 1.52$$

$$= \sin^{-1} 0.33$$

$\theta_r = 19.21^\circ \approx 19^\circ$

Question # 2

A radio transmitting station operating at a frequency of 120MHz has two identical antennas that radiate in phase. Antenna B is 9.00m to the right of A. Consider point P
between the antennas and along the line connecting them, a horizontal distance \( x \) to the right of antenna A. For what values of \( x \) will constructive interference occur at point P?

**Solution**

Given that

The frequency of the radio transmitting station is \( (f') = 120 \text{ MHz} \)

The velocity of light in air is \( c = 3 \times 10^8 \text{ m/s} \)

The wavelength of the wave is \( \lambda = \frac{c}{f} \)

\[ = 2.5 \text{ m} \]

Given that \( AB = 9 \text{ m} \)

And now consider from the above figure \( AP = x \)

For constructive interference at P path difference = \( m\lambda \)

From the figure \( PB = 9 - x \)

For constructive interference

\[ (9 - x) - x = m\lambda, \quad 0 < x < 9 \]

\[ 9 - 2x = m\lambda. \]

For \( m = 0 \), \( x = 4.5 \text{ m} \)

For \( m = 1 \), \( 9 - 2x = 2.5 \text{ m} \) \quad i.e. \( x = 3.25 \text{ m} \)

For \( m = 2 \), \( 9 - 2x = 5 \text{ m} \) \quad i.e. \( x = 2 \text{ m} \)

For \( m = 3 \), \( 9 - 2x = 7.5 \text{ m} \) \quad i.e. \( x = 0.75 \text{ m} \)

i.e. For \( x = 4.5 \text{ m}, \ 3.25 \text{ m}, \ 2 \text{ m} \) and \( 0.75 \text{ m} \), constructive interference will occur

**Question # 3**

How is it possible to determine the direction of the polarizing axis of a single polarizer?

**Solution**

The direction of the polarizing axis of a single polarizer can be determined by passing plane polarized light through it. On rotating the polarizer, when we get maximum intensity, the axis of polarizer will be parallel to the polarization direction of the polarized light and when we get minimum intensity, the axis is perpendicular to the polarization direction.