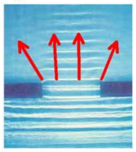
Lesson 18

Thursday, May 20, 2010
11:42 AM

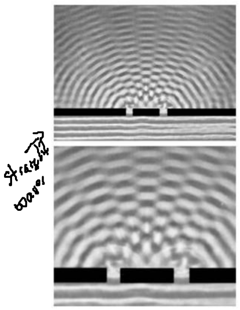
lesson3

Thursday, February 11, 2010
7:23 PM

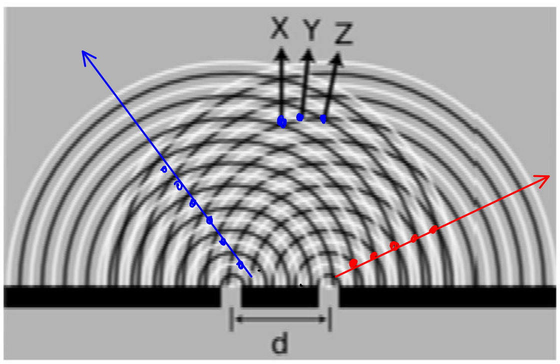
Last class we covered concepts related to refraction or bending of waterwaves



Notice how the waves are bending around the opening

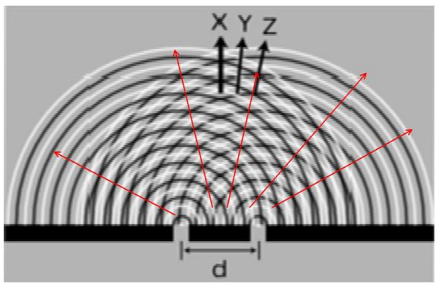


here is a diagram of a double slit interference pattern notice the straight waves approaching the barrier from the bottom



look carefully at pt x, y, z lets assume that the white bands represents troughs and black bands represent the crests.

@ Pt x we have
constructive interference
@ Pt y we have
destructive interference
@ Pt z we have
constructive interference



The lines you see in red are called antinodal lines (lines created from pts of constructive interference

These lines can be altered by changing the distance between the slits as demonstrated by app (walter-fendt)

The larger the "d" more interference patterns are created

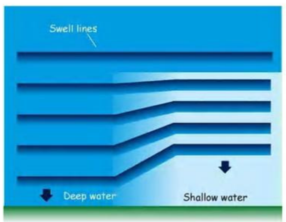
decreasing the wavelength also increases the

# of antinodal lines.

* have you ever noticed the waves near the beach, the wave lengths appear shorter as they approach the beach why?

Ans - depth of the water changes

refraction - bending of waves due to change in velocity *. Note frequency of the waves due not change *



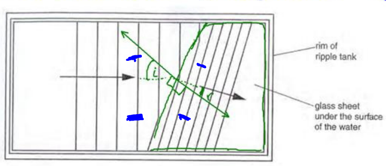
Referring to the universal wave equation

$V = \lambda f$

if frequency is constant this implies the λ is proportional to v

This means if $v \uparrow \therefore \lambda \uparrow$, due to change in the medium. For water this means that the depth has increased

Frequency is only determined by the energy source and does not change regardless of depth



Can you tell what the shape of the glass sheet is under the surface of the water?

The mathematical relationship is

$$\frac{V_1}{V_2} = \frac{\lambda_1}{\lambda_2}$$

The subscript "1" refers to the incident wave

ex) the speed of water at a certain depth is 2.50 m/s with a wavelength of 1.75 m as it encounters a new depth the wavelength changed to .85 m

Determine the new speed in the new medium

a) $\frac{V_1}{V_2} = \frac{\lambda_1}{\lambda_2}$ $\frac{2.50\,m/s}{V_2} = \frac{1.75\,m}{.85\,m}$

$V_2 = 1.2\,m/s$

Determine if it is approaching deeper or shallow region?

b) Shallow

is there a relationship between the refracted angle and the incident angle?

yes Snell's law

$$\frac{\sin \angle i}{\sin \angle r} = \frac{n_r}{n_i}$$

"n" is called the index of refraction } only for light

n_r = index of refraction for the second medium
n_i " " " " the first medium

In the case of waves it can be shown

$$\frac{\sin \angle i}{\sin \angle r} = \frac{V_i}{V_r} = \frac{\lambda_i}{\lambda_r} = \frac{n_r}{n_i}$$ } works for light

light behaves the same way, when light travels from one medium to another it obeys the same ratios

Just like the water analogy, when light enters a more dense medium it slows down therefore λ changes but frequency, which is dependent from the source, remains the same.

$$\frac{\sin \angle \theta_i}{\sin \angle \theta_r} = \frac{V_i}{V_r} = \frac{\lambda_i}{\lambda_r} = \frac{n_r}{n_i}$$

table in your book pg 353

$n_{vacuum} = 1.00$ speed of light = $3.00 \times 10^8 \frac{m}{s}$

$n_{air} = 1.0003 \doteq 1.00$

$n_{diamond} = 2.42$

ex) find the speed of light in a diamond

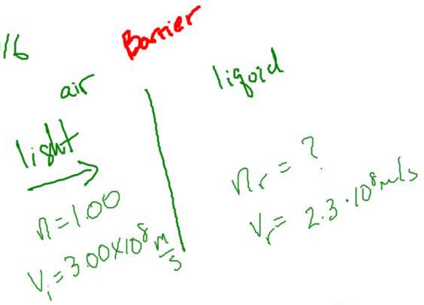
$$\frac{V_i}{V_r} = \frac{n_r}{n_i}$$

$$\frac{3.00 \times 10^8 \, m/s}{V_R} = \frac{2.42}{1.00} \qquad V_R = \frac{3.00 \times 10^8 \, m/s}{2.42}$$

$$= 1.2 \times 10^8 \, m/s$$

W/B pg 316

#2



$$\frac{V_i}{V_r} = \frac{n_r}{n_i} \qquad \frac{n_r \cdot \cancel{V_r}}{\cancel{V_r}} = \frac{n_i V_i}{V_r}$$

$$n_r = \frac{(1.00)(3.00 \times 10^8 \, m/s)}{2.3 \cdot 10^8 \, m/s}$$

$$= 1.3$$

Barrier

4) air | water

$\lambda_i = 5.3 \times 10^{-7}$ m → | $\lambda_r = ?$ →

$n = 1.00$ | $n = 1.33$

$$\frac{\lambda_i}{\lambda_r} = \frac{n_r}{n_i}$$

$$\lambda_r = \frac{n_i \lambda_i}{n_r}$$

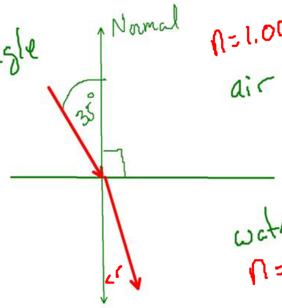
$$= \frac{(1.00)(5.3 \times 10^{-7} \text{ m})}{1.33}$$

$$= 3.98 \times 10^{-7} \text{ m}$$

Try Q #1-9 Pg 316-318

Critical angles

ex) light hits a air/water barrier at an angle of 35° determine the refracted angle



$n = 1.00$ air

water $n = 1.33$

when light travels from less dense to more dense medium

$\angle r < \angle i$

$$\frac{\sin\angle i}{\ } \quad \frac{n_r}{\ } \rightarrow \sin\angle r \cdot n_r = \sin\angle i\, n_i$$

$$\frac{\sin\angle i}{\sin\angle r} = \frac{n_r}{n_i} \Rightarrow \quad \sin\angle r = \frac{\sin\angle i \, n_i}{n_r}$$

$$\sin\angle r = \frac{.57357 \cdot 1}{1.33}$$

$$\sin\angle r = .431260$$

$$\angle r = \sin^{-1}(.431260)$$

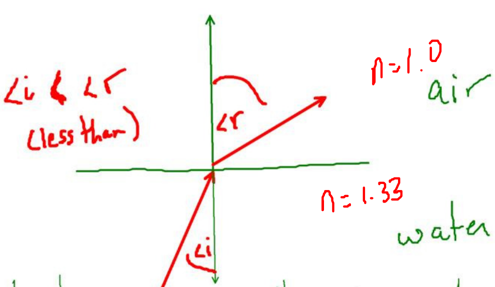
$$\doteq 26^\circ$$

try $\angle i = 55^\circ$ $\quad \angle r = 38^\circ$

$\angle i = 70^\circ$ $\quad \angle r = 45^\circ$

$\angle i = 81^\circ$ $\quad \angle r = 48^\circ$

ex



whenever looking for critical angle, the refracted angle is 90°

find critical angle $\frac{\sin\angle i}{\sin\angle r} = \frac{n_r}{n_i}$

$\frac{\sin\angle i}{\sin 90^\circ} = \frac{1.00}{1.33}$

$\frac{\sin\angle i}{1} = .7518796$

$\angle i = \sin^{-1}(\ )$

$= 49^\circ$ critical angle once $\angle i$ > than 49° you get reflection

Try Q # 1-25 odd plus 16, 18 w(B)

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