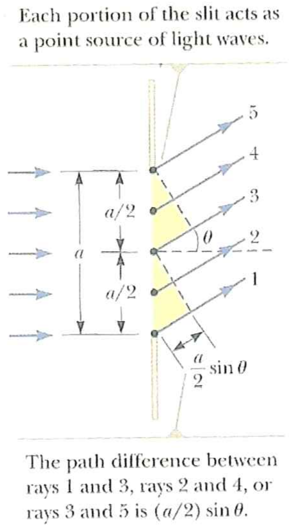


Figure 38.5 Paths of light rays that encounter a narrow slit of width a and diffract toward a screen in the direction described by angle θ (not to scale).

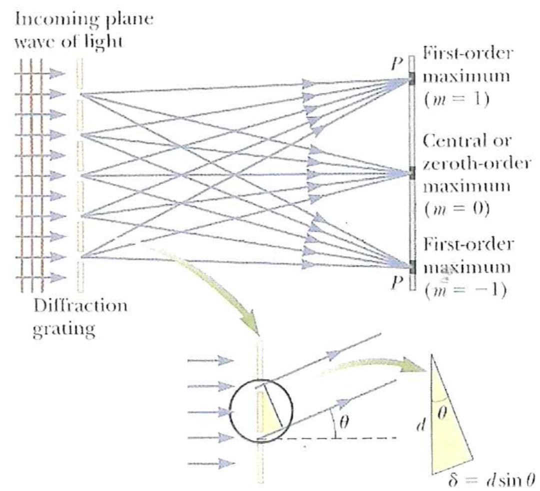
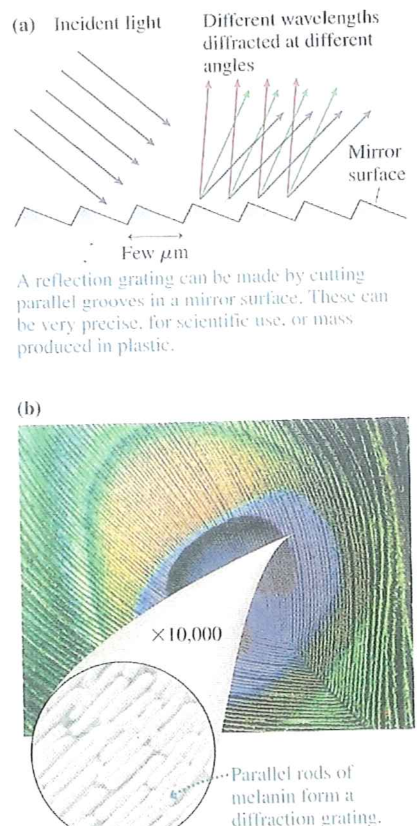


FIGURE 22.9 Reflection gratings.



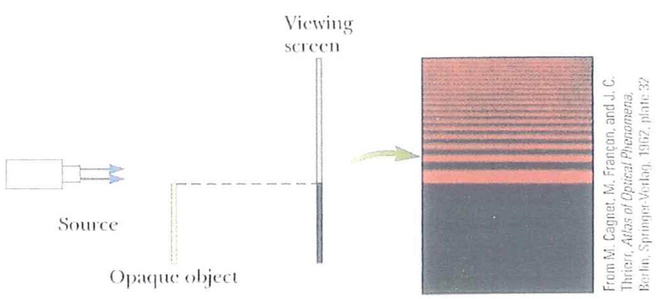


Figure 38.2 Light from a small source passes by the edge of an opaque object and continues on to a screen. A diffraction pattern consisting of bright and dark fringes appears on the screen in the region above the edge of the object.

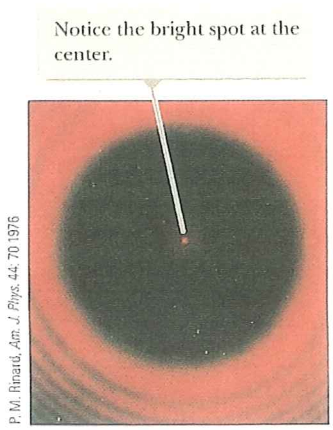


Figure 38.3 Diffraction pattern created by the illumination of a penny, with the penny positioned midway between the screen and light source.

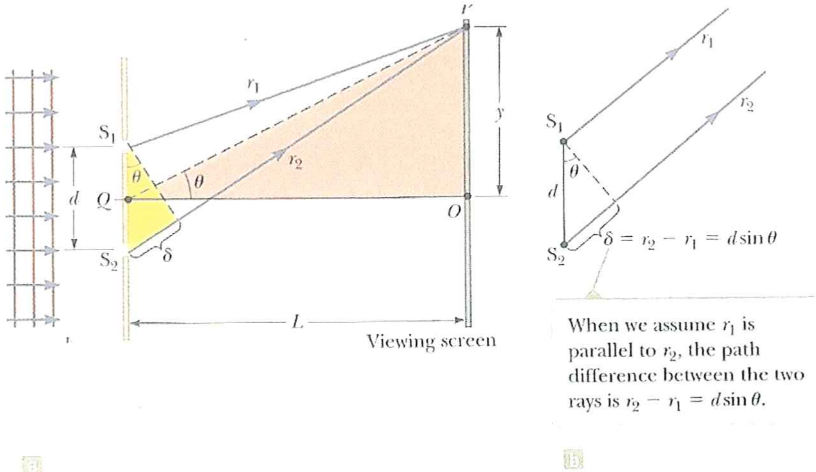


Figure 37.5 (a) Geometric construction for describing Young's double-slit experiment (not to scale). (b) The slits are represented as sources, and the outgoing light rays are assumed to be parallel as they travel to P. To achieve that in practice, it is essential that $L >> d$.

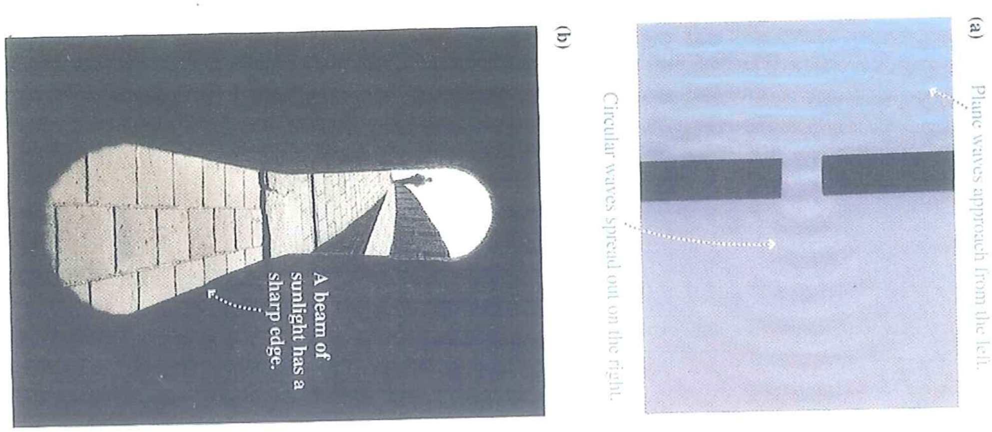
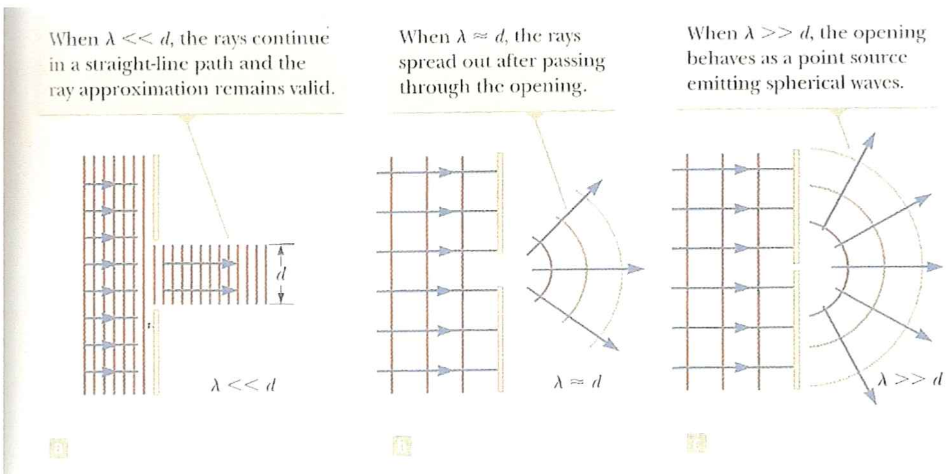


FIGURE 22.1 Water waves spread out behind a small hole in a barrier, but light passing through a doorway makes a sharp-edged shadow.

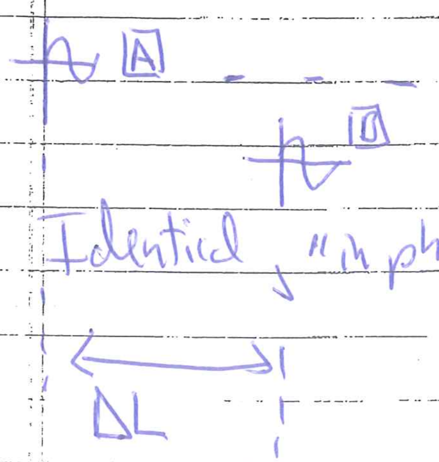


ACTIVE FIGURE 35.4

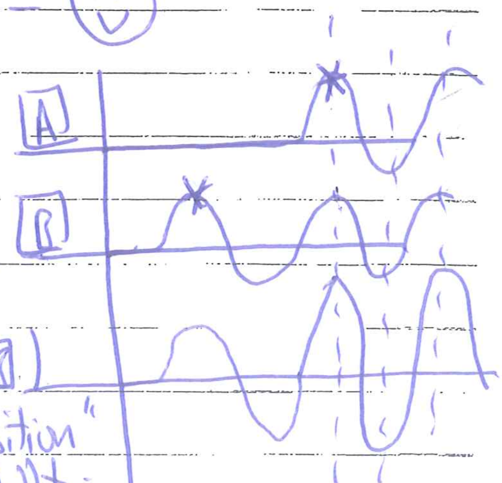
A plane wave of wavelength λ is incident on a barrier in which there is an opening of diameter d.

Thin film Interference (35.4) || different approach

Recall: Interference of Waves



Identical, "in phase"

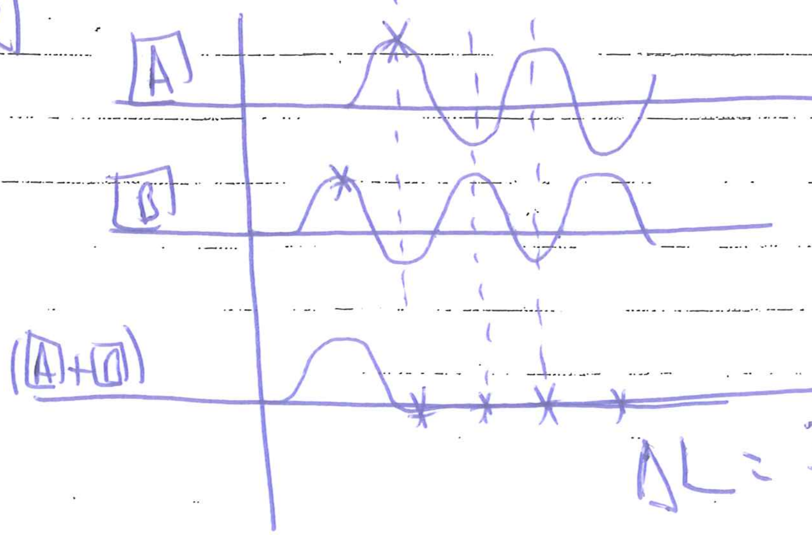


"Superposition"
Algebraic Addition

$\Delta L = 0, \lambda, 2\lambda, 3\lambda, \ldots$ CONSTRUCTIVE INTERFERENCE

↑ Shown

OR

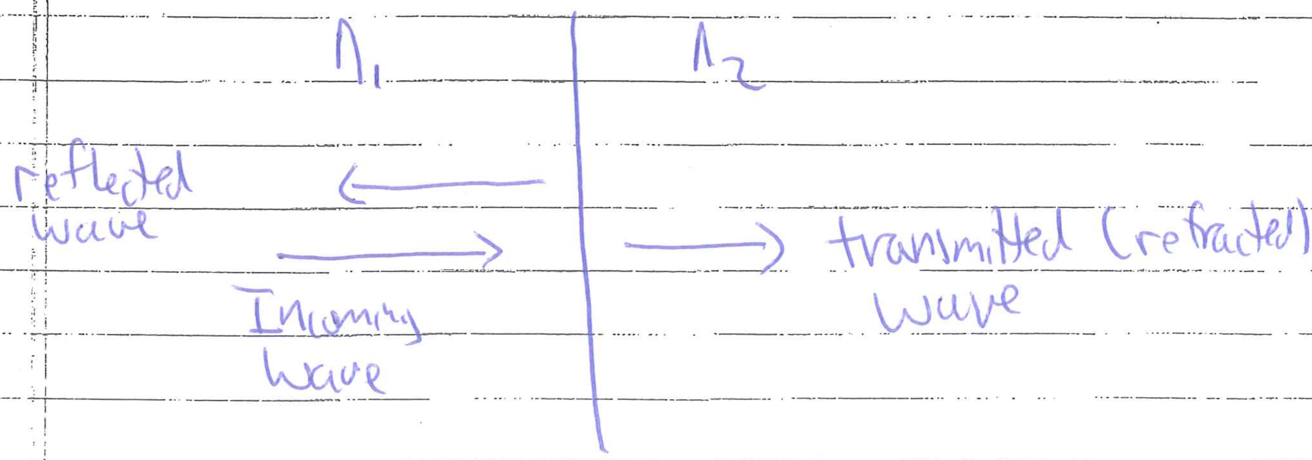


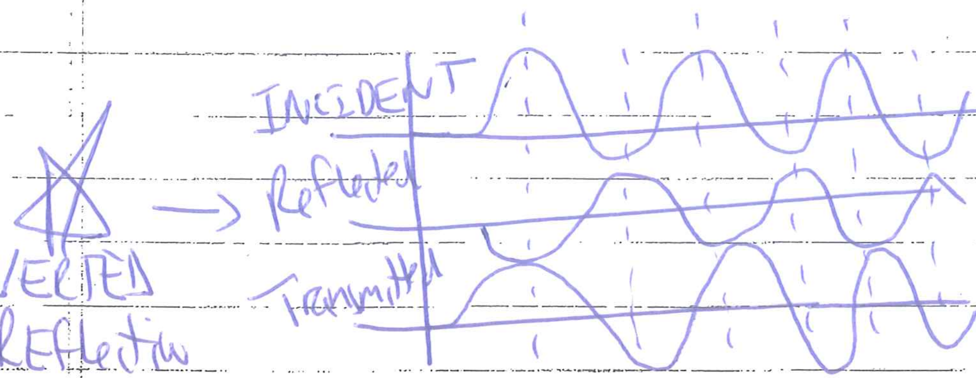
DESTRUCTIVE INTERFERENCE

$\Delta L = \frac{\lambda}{2}, \frac{3\lambda}{2}, \frac{5\lambda}{2}, \ldots$

↑ Shown

NOTE: When waves reflect from an interface, it is possible that the phase changes.





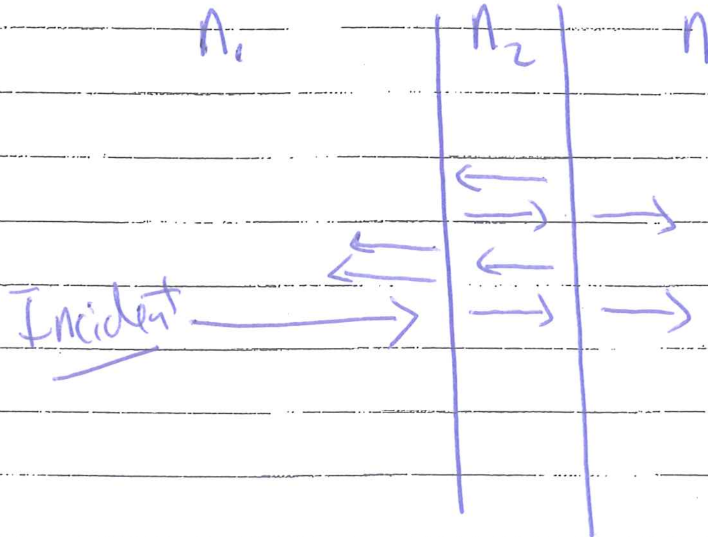
INVERTED on Reflection

NEVER CHANGES PHASE

INVERTED when $n_2 > n_1$
(phase change)

"hits a 'hard' surface"

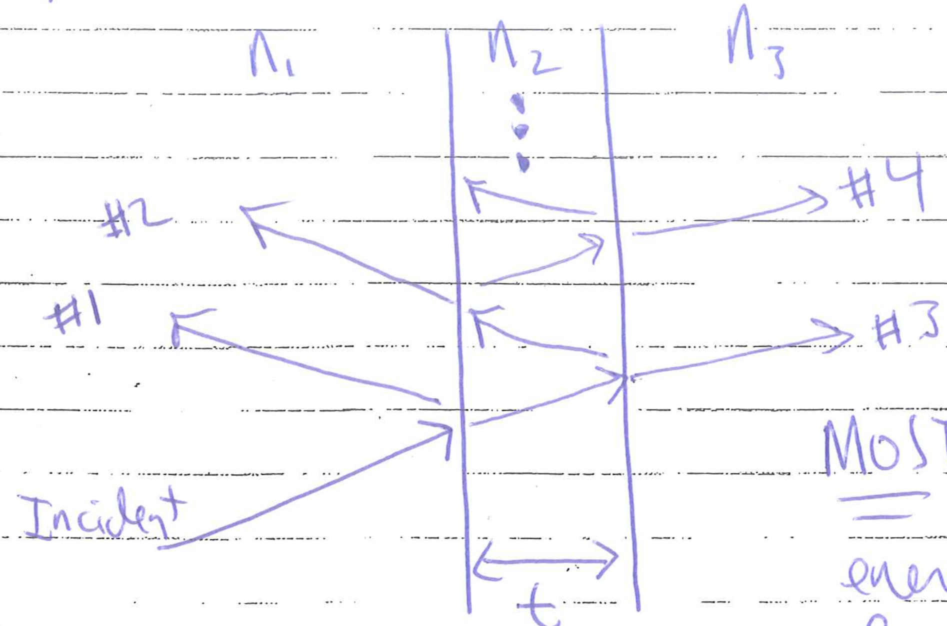
Thin films: Always assume normal incidence.



Confusing!!

SOAP film (demo)

Simple Picture:



MOST of the energy is in these four waves.

IGNORE THE REST

Reflection: (#1, #2)

Interference $\Delta L = 2t$

Compare to wavelength

BUT:
- Must compare to the wavelength in the medium where ΔL occurs.

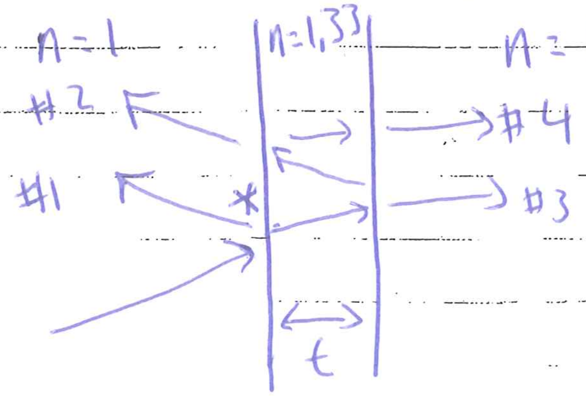
n_1	n_2
$\lambda_1 f = v_1$	$\lambda_2 f = v_2$

Note: Unless otherwise specified, wavelengths give or asked for are VACUUM* wavelengths ($n_1 = 1$, $v_1 = c$).

Short cut: $\lambda_{film} = \dfrac{\lambda_0}{n}$ *

n

EX.) A soap film ($n = 1.33$) strongly reflects red light ($\lambda = 600nm$). What are the smallest three possible thicknesses for the film?



$\lambda_{film} = \dfrac{600}{1.33} = 451nm$

- "reflection" => look @ #1, #2
- "strongly" => CONSTRUCTIVE

- Phase changes? 1 phase change

$\therefore \Delta L = \frac{\lambda_{film}}{2}, \frac{3\lambda_{film}}{2}, \frac{5\lambda_{film}}{2}, \ldots$

$\Delta L = 2t_1 = \frac{\lambda_{film}}{2}$

$\therefore t_1 = \frac{\lambda_{film}}{4} = \frac{451nm}{4} = 112.8\ nm$

$\boxed{OR}$ $\Delta L = 2t_2 = \frac{3\lambda_{film}}{2}$

$\therefore t_2 = 338.4\ nm$

$\boxed{OR}$ $\Delta L = 2t_3 = \frac{5\lambda_{film}}{2}$

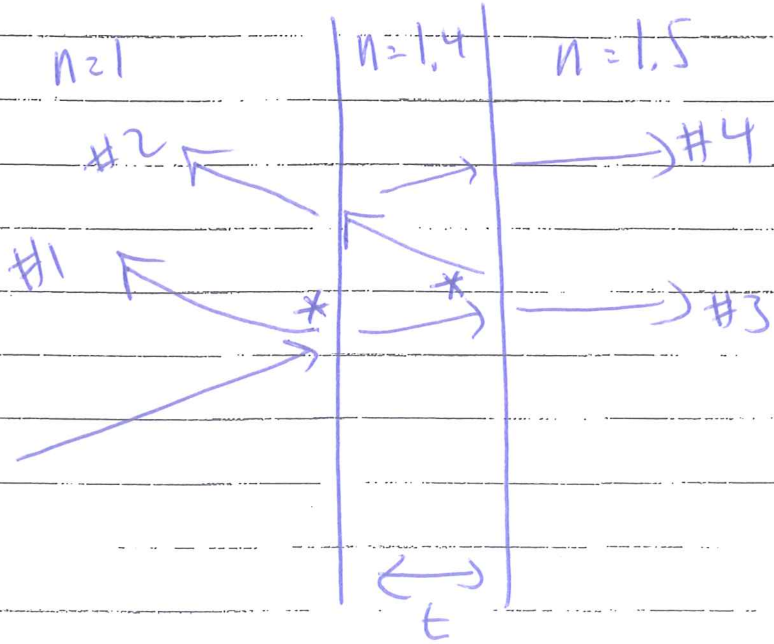
$\therefore t_3 = 564\ nm$

$\vdots$

Hmmm... A maximum in reflection corresponds to a minimum in transmission. We could have looked @ #3 and #4!!

- Destructive in #3, #4
- Phase changes? NO PHASE CHANGES
- $\Delta L = 2t = \frac{\lambda_{film}}{2}, \frac{3\lambda_{film}}{2}, \ldots$

EX.) A Thin film ($n = 1.4$) on a glass surface ($n = 1.5$



* Phase change

$$\lambda_{film} = \frac{\lambda_A}{1.4}$$

Condition for a maximum reflection for wavelength λ_A?

2 phase changes $\Delta L = 0, \lambda_{film}, 2\lambda_{film}, \ldots$

Condition for a maximum transmission for wavelength λ_A?

1 phase change $\Delta L = \frac{\lambda_{film}}{2}, \frac{3\lambda_{film}}{2}, \ldots$