Chapter 41 Problems

Problem 1:

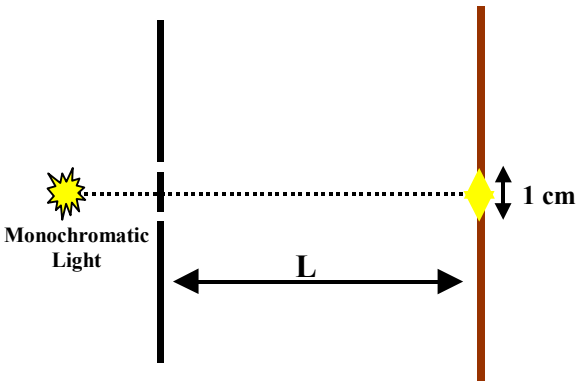
Light from a small region of a **100 Watt** incandescent bulb passes through a yellow filter and then serves as the source for a Young's double-slit interference experiment. Which of the following changes would cause the interference pattern to be more closely spaced?

(a) Use a blue filter instead of a yellow filter
(b) Use a 10 Watt bulb
(c) Use a 500 Watt bulb
(d) Move the bulb closer to the slits
(e) Move the slits closer together

Problem 2:

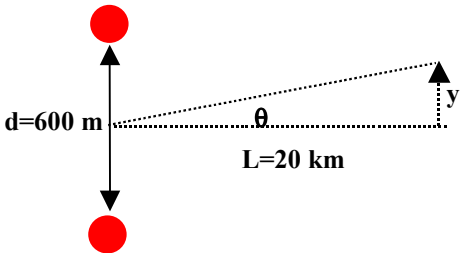
The characteristic yellow light of sodium lamps arises from two prominent wavelengths in its spectrum, at approximately **589.0 nm** and **589.6 nm**, respectively. The light passes through a double slit and falls on a screen **10 m** away. If the slits are separated by a distance of **0.01 mm**, how far apart are the two second-order bright fringes on the screen (**in mm**)?

Problem 3:



A monochromatic light placed equal distance from two slits a distance **d** apart produces a central bright spot with a width of **1 cm** on a screen located a distance **L** away, as shown in the **figure**. If the entire apparatus is immersed in a clear liquid with index of refraction **n** the width of the central bright spot shrinks to **0.75 cm**. What is the index of refraction **n** of the clear liquid? (Note: assume L >> d)

Problem 4:



Two radio antennas are **600 m** apart along a north-south line and broadcast in-phase signals at frequency **1.0 MHz**. A receiver placed **20 km** to the east, equidistant from both antennas, picks up an acceptable signal (see **Figure**). How far due north of the present location (**in km**) would the receiver again detect a signal of nearly the same intensity?

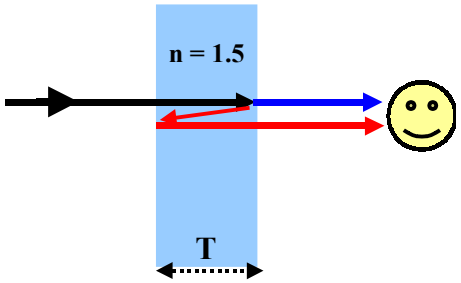
Problem 5:

Monochromatic light is incident on a two slits **0.2 mm** apart. If the first order bright fringe is **4.8 mm** from the central bright spot on a screen located a distance of **1.5 m** from the double slit, what is the wavelength of the light (**in nm**)?

Problem 6:

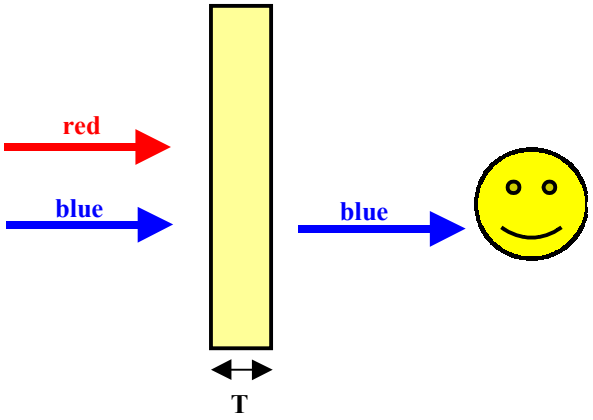
A soap (water!) film has refractive index **1.34** and is **550 nm** thick. What wavelengths of visible light (**in nm**) are **not** reflected from it when it is illuminated from directly above by sunlight?

Problem 7:



A beam of **600 nm** light is incident on the left side of a flat glass plate with refractive index **1.5** and part of it undergoes reflection between the faces of the plate as shown in the **Figure**. What minimum nonzero thickness **T** (**in nm**) of the glass plate will produce maximum brightness in the transmitted light?

Problem 8:

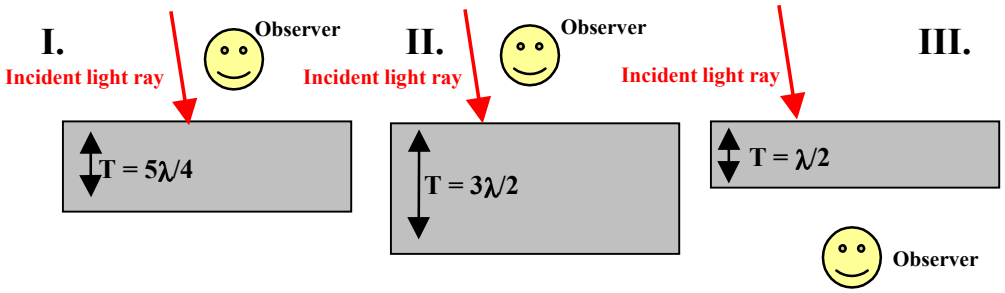


A beam of red light (λ_{red} = **600 nm**) and a beam of blue light (λ_{blue} = **450 nm**) are incident on the left side of a flat glass plate with refractive index **1.5** as shown in the **Figure**. An observer on the other side of the glass plate sees a bright blue light (maximum constructive interference) and sees no red light (maximum destructive interference). What is the thickness T (**in nm**) of the glass plate?

Problem 9:

A thin film of gasoline with a thickness of **400 nm** floats on a puddle of water. Sunlight falls almost perpendicularly on the film and reflects into your eyes. If $\mathbf{n_{gas}}$ = **1.4** and $\mathbf{n_{water}}$ = **1.33**, which of the following wavelengths will be missing from the reflected beam due to destructive interference?

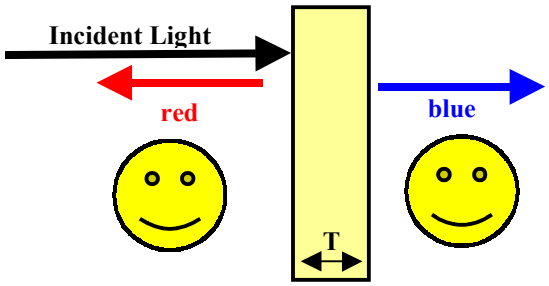
(a) 280 nm (b) 320 nm (c) 373 nm (d) 400 nm (e) 560 nm



Problem 10:

Three experiments involving a thin film (**in air**) are shown in the **Figure**. If **T** indicates the film thickness and **λ** is the wavelength of the light in the film, which experiments will produce **constructive** interference as seen by the observer?

Problem 11:



Two observers are on opposite sides of a flat glass plate with refractive index 1.5 as shown in the **Figure**. If the light is incident from the left and if the observer on the left sees maximum constructive interference for red light (λ_{red} = **600 nm**) and the observer on the right sees maximum constructive interference for blue light (λ_{blue} = **450 nm**), what is the thickness T (**in nm**) of the glass plate?