Physics 1214, Homework #9 (due 11/7)

M1 The formula $y_m = R\dfrac{m\lambda}{d}$ for the location of the points of constructive interference from the two slits is valid

A. only for large angles θ.

B. only for small angles θ.

C. for all angles θ, because it is a general formula.

M2 After a laser beam of wavelength λ passes through a diffraction grating, the second-order bright spot occurs at an angle of 30° from the original direction of the beam. You now shine a different laser beam through this grating and find that the second-order bright spot occurs at 60° with respect to the original beam direction. The wavelength of the second beam is

A. $\dfrac{\lambda}{2}$.

B. $\dfrac{\lambda}{\sqrt{3}}$.

C. $\lambda\sqrt{3}$.

D. 2λ.

Problems

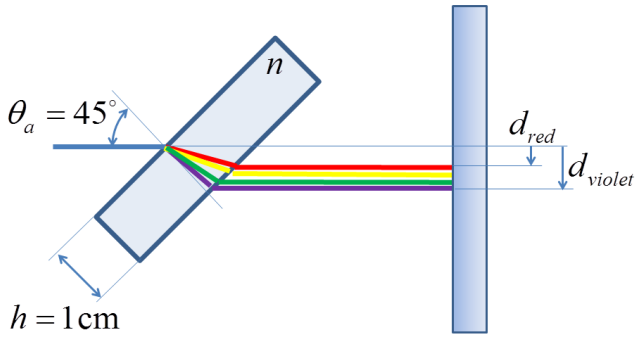
P1 In Young's experiment performed using a red laser ($\lambda = 610$ nm), the distance between the two adjacent bright fringes is ten times larger than the distance between the slits. If the distance to the screen is $R = 1$ m, what is the distance between the slits?

P2 A monochromatic blue light ($\lambda = 450$nm) is incident on a diffraction grating with a spacing of 2 μm. What is the total number of the intensity maxima? (Hint: use the fact that $|\sin\theta| < 1$).

P3 A white light beam is incident at 45° on a transparent plate of a thickness of 1 cm, which refractive index n depends on the light wavelength λ as

$$n = 1.201 + \frac{0.049}{(\lambda[\text{nm}]/300)^2}.$$

Determine the size of the rainbow spot at a screen placed behind the plate perpendicular to the beam. Assume that the size of the spot is defined as the difference between the lateral displacements of the violet ($\lambda = 300$ nm) and the red ($\lambda = 700$ nm) light component.



P4 A planoconvex lens with a focal length of 20 cm is made of glass with refractive index $n = 1.5$. What is the radius of the first red ($\lambda = 650$ nm) Newton's ring?