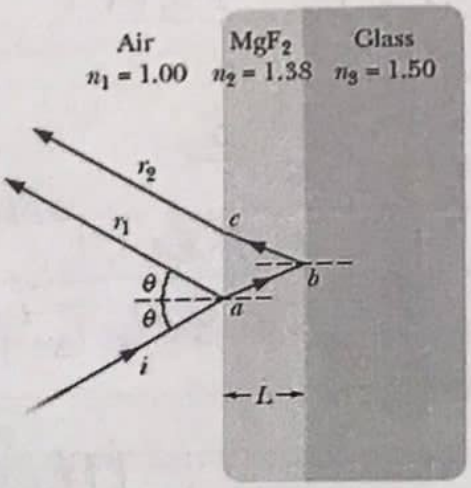
Ministry of Higher Education		
Higher Institute for Engineering and Technology at Manzala		
First Semester		Date:7 /12/2020
Mid-term Exam		Year: 1
Department: Civil & electronic Eng.		Time allowed: 60 mins.
Total mark:		Code: BS111

Course title : Physics 3..... اسم الطالب : .....

Answer all of the following questions

Q1: Glass lens is coated on one side with a thin film of magnesium fluoride (MgF_2) to reduce reflection from the lens surface. The index of refraction of MgF_2 is 1.38; that of the glass is 1.50. What is the least coating thickness that eliminates (via interference) the reflections at the middle of the visible spectrum (λ= 550 nm)? Assume that the light is approximately perpendicular to the lens surface.



m = 0

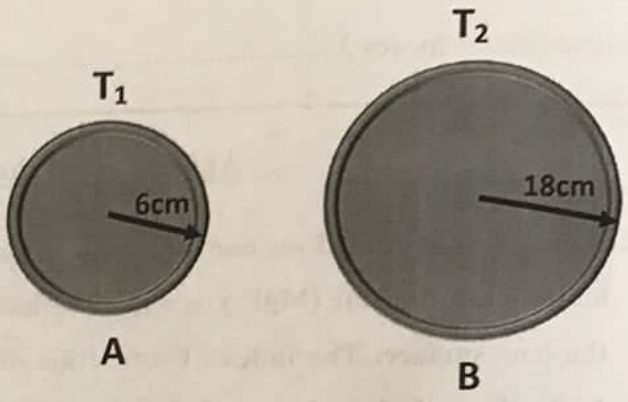
$$2L = \left(m + \frac{1}{2}\right)\frac{\lambda}{n_2}$$

$$2L = \left(0 + \frac{1}{2}\right)\frac{(550 \times 10^{-9})}{1.38}$$

$$L = 9.96 \times 10^{-8}\ m$$

$$= 99.6\ nm$$

Q2: Two spherical bodies A (radius 6 cm) and B (radius 18 cm) are at temperatures T_1 and T_2 respectively. The maximum intensity in the emission spectrum of A is at 500 nm and in that of B is at 1500 nm. Considering them to be black bodies, What will be the ratio of the rate of total energy radiated by A to that of B? Then draw the relation between the rate of total energy and wavelength (Planck's theory) for two bodies.



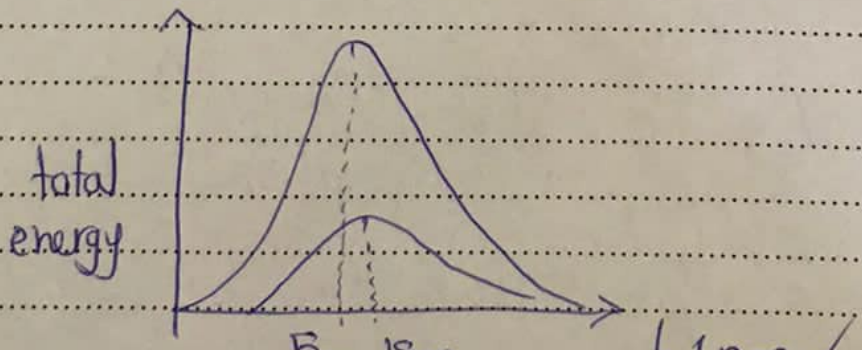
$P_{rad} = \sigma \varepsilon A T^4$

ratio

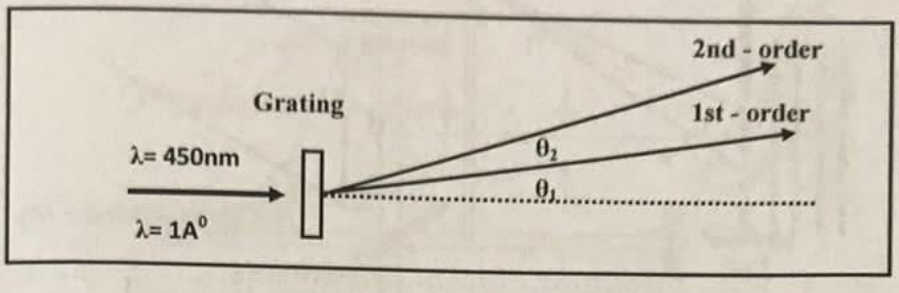
$\frac{P_1}{P_2} = \frac{\sigma \varepsilon A_1 T_1^4}{\sigma \varepsilon A_2 T_2^4}$ Black body $\varepsilon = 1$

$= \frac{\pi (6\times10^{-2})^2 (1/\lambda_1)^4}{\pi (18\times10^{-2})^2 (1/\lambda_2)^4} = \frac{(6\times10^{-2})^2 (1/500\times10^{-9})^4}{(18\times10^{-2})^2 (1/1500\times10^{-9})^4}$

$= \boxed{9}$



Q3: A standard optical diffraction grating can be used to discriminate between different wavelengths in the visible range ($\lambda = 450$ nm) but can't be used in case of x-ray wavelength range ($\lambda = 1\ A^0$). Show that for the first and second order maximum? a grating spacing d=5000nm.



$m\lambda = d \sin\theta$

$m = 0, 1$ for $\lambda = 450$ nm

* $(1)(450 \times 10^{-9}) = (5000 \times 10^{-9}) \sin\theta_1$

$\theta_1 = 5.163^\circ$

* $(2)(450 \times 10^{-9}) = (5000 \times 10^{-9}) \sin\theta_2$

$\theta_2 = 10.369^\circ$

for $\lambda = 1\ A$

* $m = 1 \ldots (1)(1 \times 10^{-10}) = (5000 \times 10^{-9}) \sin\theta_3$

$\theta_3 = 1.145 \times 10^{-3}{}^\circ$

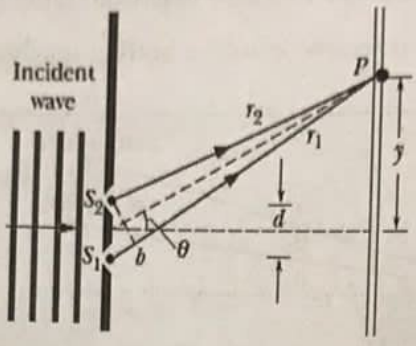
* for $m = 2$

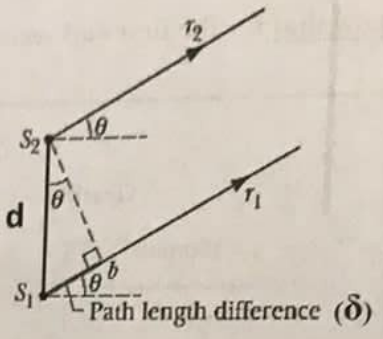
$(2)(1 \times 10^{-10}) = (5000 \times 10^{-9}) \sin\theta_4$

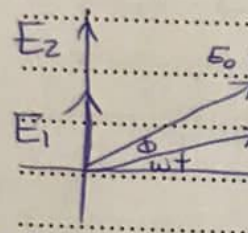
$\theta_4 = 2.29 \times 10^{-3}{}^\circ$

التعليق ... لانه تطبق ملاحظة الجود في حالة $\lambda = 1A$ لانه صغير جدا مقارنة بـ ($d = 5000$ nm)

Q4: Derive an expression for the intensity in double-slit interference, Then calculate the intensity of laser beam (λ=625nm) fringe at point P. In case of d = 0.5μm, θ =30 and I_0 = 20 Lux.

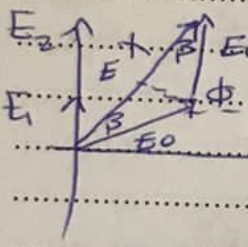






① $E_1 = E_0 \sin \omega t$

② $E_2 = E_0 \sin(\omega t + \phi)$



$\Phi = \beta + \beta = 2\beta$

$\beta = \frac{1}{2}\phi \quad \therefore \cos\beta = \frac{X}{E_0}$

حل آخر

$X = E_0 \cos\beta$

$\sin\theta = \frac{\delta}{d}$

$\frac{1}{2}E = E_0 \cos\beta$

$\delta = \sin\theta \, d = \sin 30 (0.5\times10^{-6})$

$E = 2E_0 \cos\beta$ بتربيع الطرفين

$= 250 \text{ n.m}$

$\therefore \phi = \frac{2\pi}{\lambda}\delta = \frac{2\pi}{625}(250)$ والتعويض عن β

$E^2 = 4E_0^2 \cos^2\frac{1}{2}\phi$ $\frac{1}{2}\phi$ ؟

$= \frac{4}{5}\pi^c$ علماً بأن $I \propto E^2$

$\boxed{I = 4I_0 \cos^2\frac{1}{2}\phi}$

$\therefore I = 79.96°$ بالتعويض في القانون

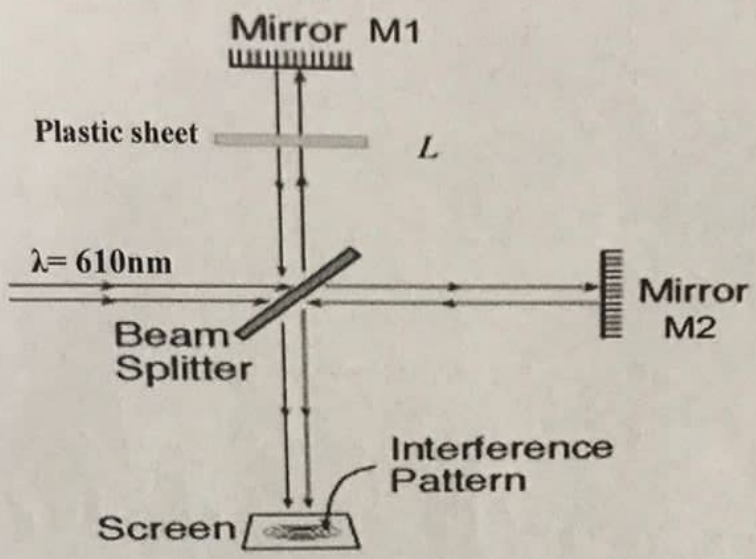
$I = 4(20)\cos^2\frac{1}{2}\left(\frac{2\pi}{(625)}(md\sin\theta)\right)$

$\frac{2\pi}{\lambda}(md\sin\theta) = \boxed{\frac{2\pi}{\lambda}\delta} = \phi$ قانون

$= 4(20)\cos^2\left(\frac{1}{2}\left(\frac{2\pi}{625}(1(0.5\times10^{-6})\sin(30)\right)\right)$

$= 79.96°$

Into one arm of a Michelson interferometer, a plastic sheet (n = 1.4) is inserted, which causes a ft in the interference pattern by 86 fringes. The light source has wavelength of 610 nm in air. hat is the thickness of this plastic (L)?



$N_m - N_{air} = \frac{2L}{\lambda}(n-1)$

$86 = \frac{2L}{(610\times10^{-9})}(1.4-1)$

$L = 6.55\times10^{-5}\ m$

$= 65.57\times10^{3}\ nm$

The end of exam

Good luck

Dr. Ali Samir Awad