參考用

科目：光　　學(500C)　　校系所組：中大光電科學與工程學系、照明與顯示科技研究所
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1. 有一雙筒望遠鏡系統如左下圖所示，其規格為 8x25，前面數字 8 即是倍率 8 倍的望遠鏡，後面數字 25 即標示物鏡直徑為 25 mm。

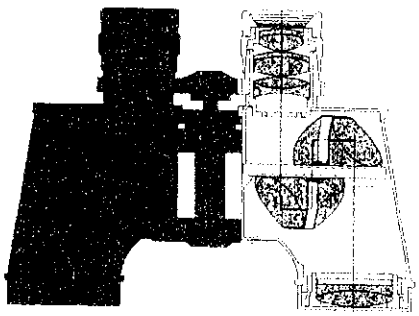
(a) (6%) 請計算望遠鏡系統之出瞳(exit pupil)口徑大小?

(b) (6%) 物鏡焦距為 100 mm，則目鏡焦距為何?

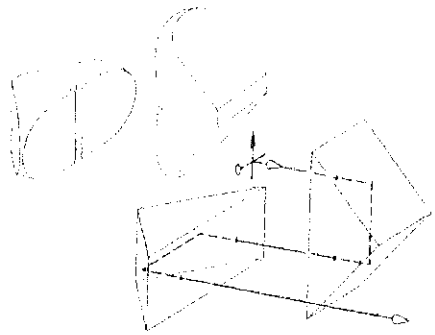
(c) (6%) 設此望遠鏡可觀看物體實際視野(field of view)為 6°，則人眼觀賞視野為多少?

(d) (6%) 甲生在洋基球場觀看王建民投球，甲生與王建民相對距離為 130 m，王建民身高為 192 cm，利用此望遠鏡把王建民拉至明視距離(25 cm)，則在望遠鏡所看到王建民之成像高度為何?

(e) (6%) 一入射光線之像方向為  如右下圖經過 Porro prism 後之出射光線像方向為(A)  (B) (C)  (D)  。



8x25 雙筒望遠鏡



Porro prism

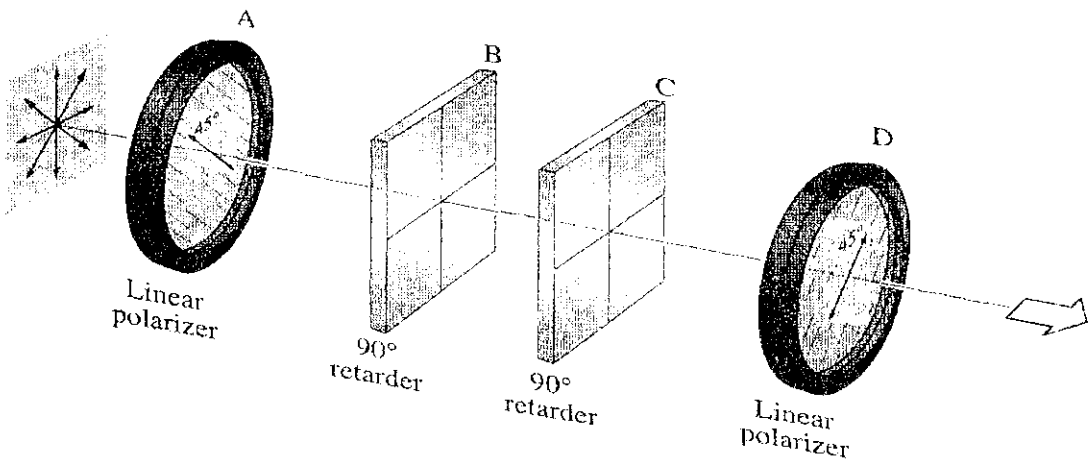
2. 假設不考慮各光學元件的損耗、也不考慮空氣對光束傳遞時的影響。現在有一無特定偏振的平面波光束 (unpolarized plane wave)，如下圖所示，依序由左向右傳播。請依序分別估計在通過各光學元件後，此光束的強度變化與偏振狀態。(如有需要任何未定之規格參數，請自行設定加入)

(a) (3%) 通過 A: 45° linear polarizer 後的強度變化比例、與偏振狀態；

(b) (3%) 通過 B: 90° retarder 後的強度變化比例、與偏振狀態；

(c) (2%) 通過 C: 90° retarder 後的強度變化比例、與偏振狀態；

(d) (2%) 通過 D: 135° linear polarizer 後的強度變化比例、與偏振狀態。



注意：背面有試題

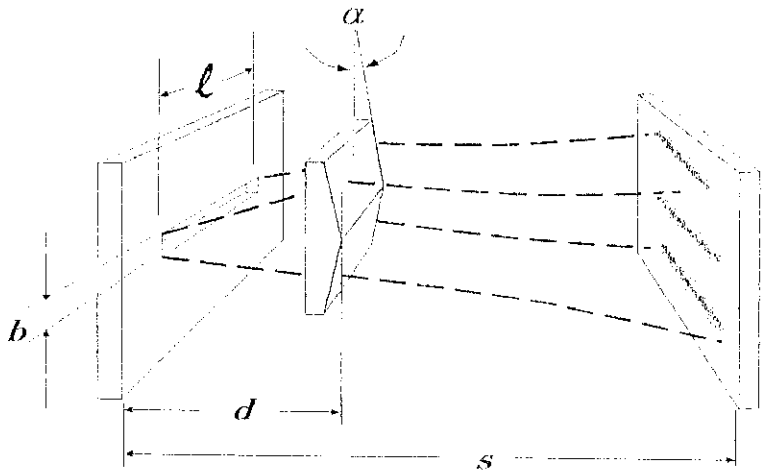
3. 下圖為 Fresnel's biprism 系統，試討論一平面波入射後，所形成之繞射與干涉現象。

(a) (10%) 若 biprism 的折射率為 n，試估計 biprism 對單狹縫的作用結果；

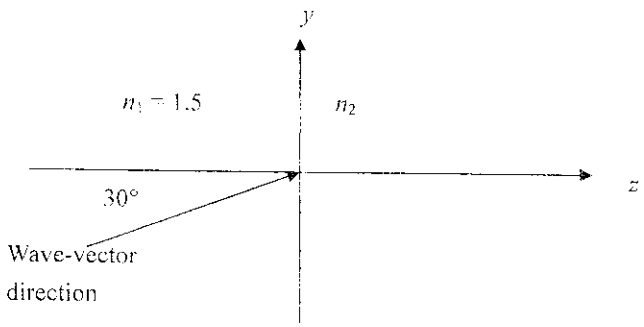
(b) (5%) 決定干涉現象形成亮、暗區的條件；

(c) (5%) 若滿足 Fraunhofer condition，則繞射現象所形成亮、暗區的條件；

(d) (10%) 綜合以上分析，在系統右方的投射幕上，決定所可能觀察到圖案與光強度分佈。



4. The amplitude of the electric field of a time-harmonic plane wave is 10 V/m in vacuum. Assume that this plane wave has a wavelength of 2/3 μm when propagating in a glass of refractive index = 1.5 in the $z \le 0$ region. The wave vector of this plane wave is in the y-z plane and along a direction +30° from the z axis, as shown below. (Grading is base on correct concepts and derivations, but not on exact numerical solutions.)



(a) (2%) Is this electromagnetic wave visible to your eyes in air? If visible, what color is it?

(b) (4%) What is the frequency of this wave in units of Hz?

(c) (4%) What is the phase velocity of this wave along the wave-vector direction in $z \le 0$?

(d) (4%) Suppose the electric field is zero when time $t = 0$ at the origin of the coordinate system. Write a scalar expression of the electric field of this plane wave in the region $z \le 0$.

(e) (4%) What is the radiant flux density or the average intensity of this wave in air in units of Watt/cm^2? The intrinsic wave impedance is $\sqrt{\mu_0/\varepsilon_0}$ = is 377 Ω in vacuum.

(f) (4%) What is the mean photon flux density of this wave in air in units of number of photons per second per square centimeters? Planck's constant is approximately 6.6×10^{-34} J·s.

(g) (4%) Assume a material of refractive index n_2 fills up the space $z \ge 0$. What is the maximum value of n_2 that would make the incident wave undergo total internal reflection at the interface $z = 0$?

(h) (4%) If the incident angle of 30° is a Brewster angle and you do not detect any reflection from the $z = 0$ interface, what is the polarization direction of the wave and what is the refractive index n_2?