Paper-III Group-A

Que. Describe the construction and action of a Babinet's compensator. Describe its use in the analysis of an elliptically polarised light?

OR,

Explain a Babinet compensator and discuss how it can be used by kerrespect?

Ans → Babinet's compensator →

It is useful device used in the production and analysis of elliptically polarised light. It consists of two quartz wedge of equal small accute angles, placed with their hypotenuse in contant so as to form a small rectangular block. The wedge on the left is cut with its optics axis perpendicular to the refracting edge and that on the right with its optices axis

parallel to the refracting edge. one of the wedge is fixed, while the other can be moved in its own plane by means of a micrometer screw.

When plane polarised light falls normally on the first wedge with its plane of vibration making an angle θ with the optics axis it is broken up into E and O components. the E components parallel to the optic axis travels slower than the O-components perpendicular to the optic axis on entering the second wedge, the E components becomes the O-components and vice-versa. In other words the two components exchanges velocities in passing from the one wedge to the other, thus the two wedge tend to cancel each others effects.

Let t_1 and t_2 be the thickness of two wedge shaped section A and B traversed by a particular ray. and μ_e and μ_o the refractive indies of Quartz

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for the E and O components respectively. Then the path difference introduced between the two components by the first wedge is $t_1(\mu_e - \mu_o)$ and that introduced by the second wedge is $t_2(\mu_e - \mu_o)$. Hence, the resultant path difference

$$= (t_1 - t_2)(\mu_e - \mu_o).$$

At the centre of the compensator where $t_1 = t_2$ the resultant path difference is zero so that the emergent light is plane-polarised

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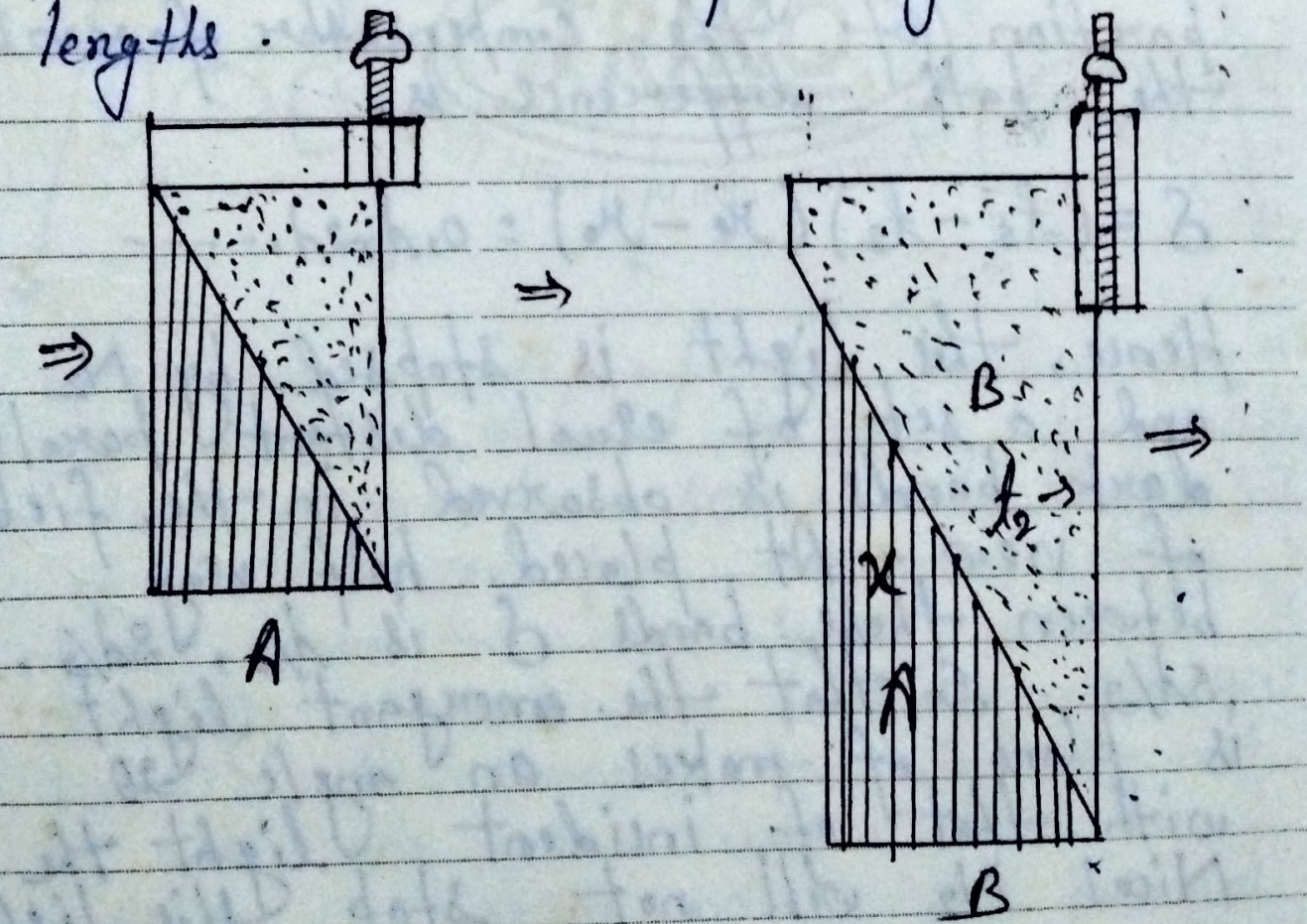
in the original plane. The crystals A and B are mounted such that A is fixed and with the help of a rack and pinion arrangement. In this way $(t_1 - t_2)$ can be made to have any desire value.

By moving the second wedge relative to the first, any value of ~~centre~~ $(t_1 - t_2)$ can be arranged at the centre of the compensatore and then this portion can be used as a quartz wave plate. thus the compesatore has an advantage other a quarter - wave - plate the quarty wave - plate produce a path difference of 1/4 for one particular wave-length. where as the compensatores can be used be adjusted for any wave-lengths.



Analysis of elliptically polarised light using Babinet's compensator.

Colibration :→

It is first necessary to celibrate the micrometere screw of the compensatore. the experimental arerangement is shown in fig [A3]. the compensatore C is placed between two crossed nicols N_1 and N_2 (polarised and analyser). the plane polarised light travelsing there portion of the compensatore for which the path difference is,

$$\delta = (t_1 - t_2)(\mu_e - \mu_0) = 0, \lambda, 2\lambda, \text{---}$$

Hence, this light is stopsed by N_2 and a set of equal distant parallel dark bands is observed in the field of view. At placed half way between those bands δ is $\lambda/2, 3\lambda/2, 5\lambda/2$. So that the emergant light is plane of makes an angle 2θ with that of incident light the Nicol N_2 will not stop this light

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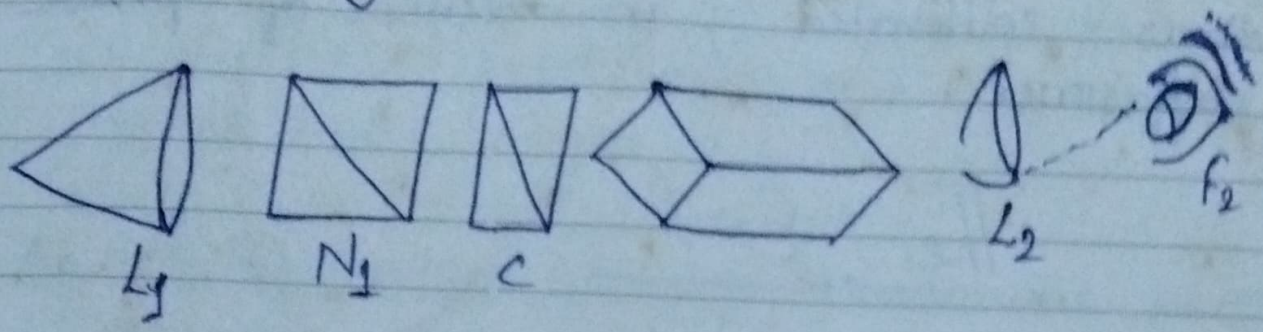
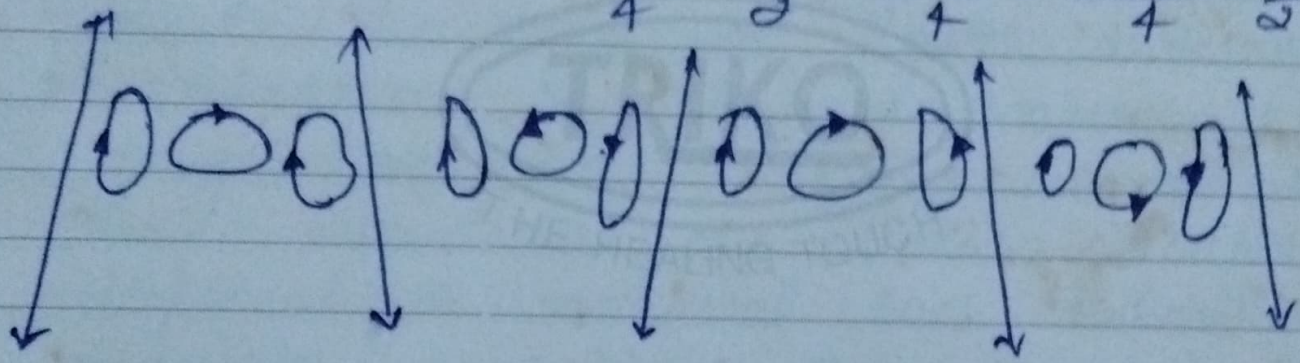
and $\theta = 45^\circ$. If white light is used, only others will be coloured.



$$\delta = -2\pi \cdot \frac{7\pi}{4} - \frac{3\pi}{2} - \frac{5\pi}{4} - \pi - \frac{3\pi}{4} - \frac{\pi}{2} \cdot 0 -$$

$$\frac{\pi}{4} \cdot \frac{\pi}{2} \cdot \frac{3\pi}{4} - \frac{\pi 5\pi}{4} \cdot \frac{3\pi}{2} \cdot \frac{7\pi}{3} \cdot 2$$



When one wedge of the compensator is moved relative to other by rotating the micrometer screw. The position of the zero path difference shifts there fore the dark bands move laterally across the field of view the screw is turned to bring the next b and one cross wire and the reading is again noted. this produced

is repeated for a number of bands and α is obtained the screw is thus calibrated in term of phase difference.

The End