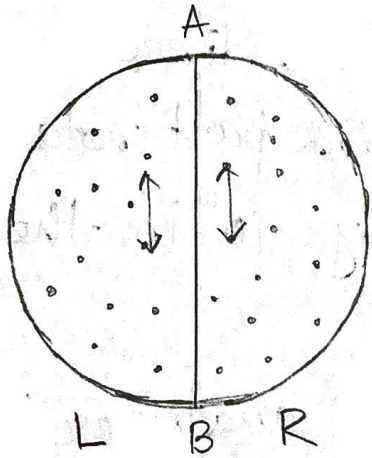
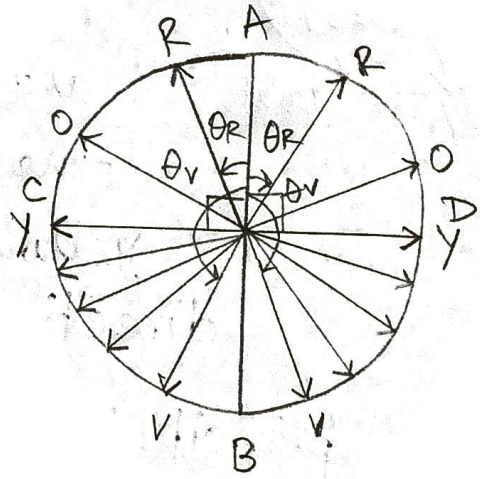
BI-QUARTZ POLARIMETER:

This is used with white light & uses a bi-quartz plate in place of a half-shade plate.

A bi-quartz plate consists of two sem-circular quartz plates, two of different handedness, cemented together to form a circular plate.

The plates are cut so as ~~to~~ that the optic axes for both are perpendicular to the refracting face & the thickness is ~~so~~ chosen so as to rotate the yellow wave of white light by an angle of 90°.





The principal section of the polarizing Nicol prism is so aligned that the plane polarized vibrations are parallel to the joining edge for the crystals, i.e., along AB.

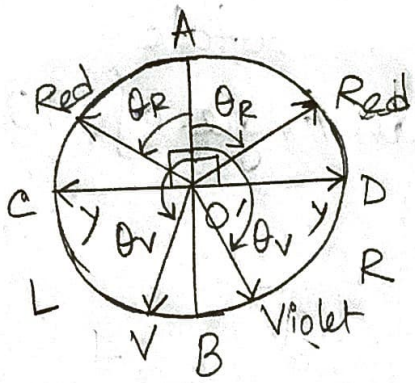
Due to optical dispersion, the various colours are rotated by different degrees as,

$$\theta \propto \frac{1}{\lambda^2}$$

So the violet colour is more rotated than the red, i.e., $\theta_R < \theta_V$.

The rest of the wavelengths have intermediate values of rotation.

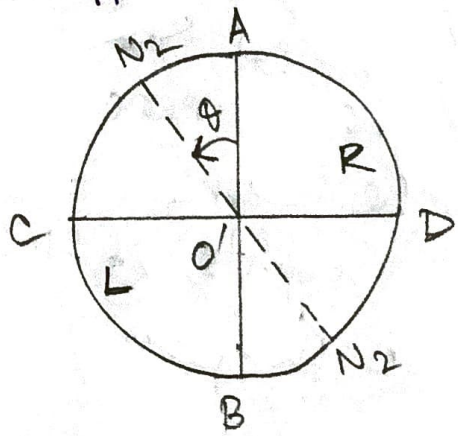
The plane polarized white light be incident on the biquartz plate. The direction of vibration is parallel to AO'B, which has been fixed by the construction of the polarimeter.



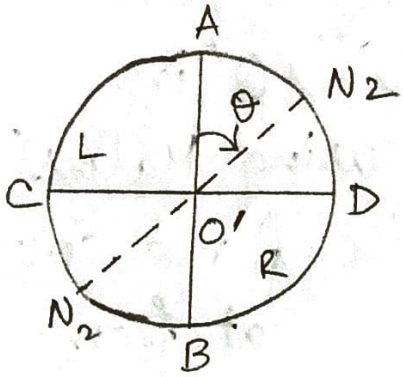
The L-handed quartz rotates the yellow light by 90° in the anti-clockwise direction while the R-handed part rotates the yellow light by 90° in the clockwise direction.

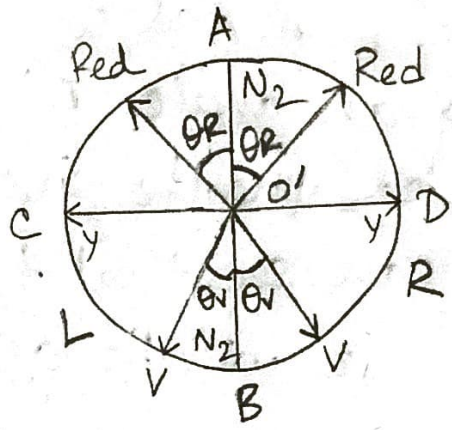
(1) Now if the principal plane of the analyzer is kept parallel to CO'D, then only the yellow light ~~gets~~ passes through it & since both the plates are of equal thickness (3.75mm) the intensity of yellow light seen is uniform over the field of view
Some component of other colours are also received by the analyzer ~~by~~ but these are of low intensity & does not change the uniform yellow colour obtained much.

(2) If the principal section of analyzer is kept making an angle $\theta (< 90^\circ)$ with AO' in the L-handed quartz side, then using Malus' law we can see that the intensity of red colour from L side will be greater than that from the R side. Again intensity of violet colour from L side reaching analyzer will be less ~~if~~ than that ~~obtained~~ reaching from the R side. Hence the L side will appear reddish while the R side will appear bluish.



(3) If the principal section of analyzer is kept making an angle $\theta (< 90^\circ)$ with AO' in the R-handed side, the ~~the~~ intensity of red colour reaching will be greater than that reaching from L-handed side. Again the violet colour reaching the analyzer from the L-side will be of higher intensity than that from the R-side. Hence, the L-side will appear bluish while the R-side will appear reddish.





(4) If the principal section of N_2 is placed along AO'B, then the vibrations of yellow light will be perpendicular to it & hence no yellow light will pass through to the telescope.
Again the intensities of Red colour from both sides of the biquartz reaching the analyzer are equal. The same is true for blue & other remaining lights of the spectrum.
We thus see a uniform pink light over the field of view.
Any slight change from this position of N_2 will give different colours from the two parts of the biquartz plate
We obtain this position of uniform pink colour as it is easier to detect by our eyes than the position of uniform yellow colour, where the intensity appears to remain uniform over a certain range of angle about CO'D.

A reference circular scale reading with plain water in the polarimeter tube is taken at the position of uniform pink colour.

As the light travels through a fixed column of optically active solution, light from both the halves are equally rotated either clockwise or anti-clockwise direction.
The analyser has to be rotated by the same amount in the same direction to get the position of uniform pink illumination.
The difference b/w the two readings will give the angle of rotation for the active soln.

In half-shade polarimeter, the birefringent property of quartz crystal is utilised as the light is made incident making an angle with the direction of optic axis.

In biquartz polarimeter, the optically active property of quartz crystal is utilised as the light is made to pass along the direction of the optic axis, when no double refraction occurs.