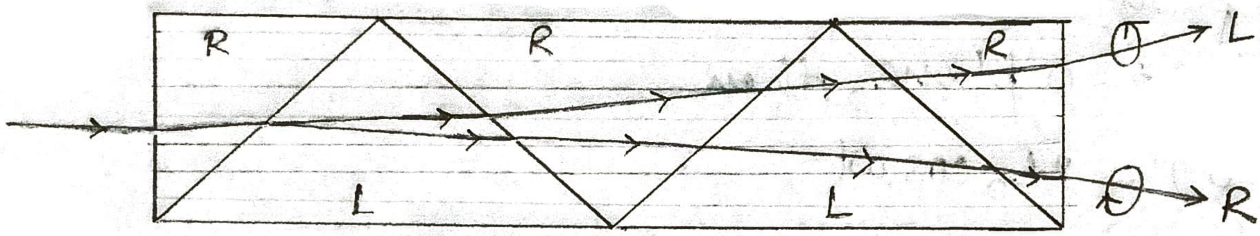
FRESNEL'S MULTIPLE/COMPOSITE PRISM :



→ optic axes for all segments

Fresnel experimentally demonstrated the double refraction into two circularly polarized rays. He failed to demonstrate the effect using a single quartz prism and, hence, constructed a train of right- & left-handed prisms cut & mounted together as above.

The prisms were cut in such a way that when arranged like above, all would have their optic axes parallel to each other & to the length of the composite prism.

When light is incident normally on the 1st crystal surface, the two component circular vibrations travel along the optic axis, with diff. velocities.

The R-state propagates more rapidly in the 1st prism than in the 2nd, so when passing through the 1st oblique boundary is refracted towards the normal to this boundary. The opposite is true for the L-state. The two rays are thus refracted

towards & away from the normal to the boundary.
At the 2nd boundary surface, the velocities are again interchanged, so that the ray bent toward the normal at the 1st oblique boundary is now bent away from it.
The angular separation b/w the two states increase with each successive refraction. The two ~~ima~~ waves coming out of the prism can be viewed with an analyzer & a QWP to find out the two ~~of~~ opposite circular polarized states.
The images seen by the analyzer will be that of two plane-polarized waves, polarized normal to each other. The images disappear alternately with each 90° rotation of the nicol.

OPTICAL ACTIVITY IN LIQUIDS:

Optical activity observed in liquids is attributed to the molecular structure.
Each molecule of an active liquid can be thought of as a small crystal with an optic axis along which the plane polarized light is rotated.
Since in liquid the molecules are oriented at random, the observed rotation ~~is~~ is an avg. effect of all the molecules & therefore the same in any direction

through the liquid.

The random orientation of the molecules would not cancel out the effect as each molecule has a screw-like arrangement of atoms, the handedness of which remains the same, no matter from which end it is viewed.

→ If an active liquid be made up of an optically active substance & an inactive solvent then the amount of rotation is proportional to the amount of the active substance present.

SPECIFIC ROTATION/ROTATORY POWER :

Specific rotation of an active solution is defined as the rotation produced by a 10 cm column of liquid containing 1g of active substance for every cubic centimeter (cc) of solution,

$$S = \frac{10 \times \theta}{l \times d}$$

where S → specific rotation,

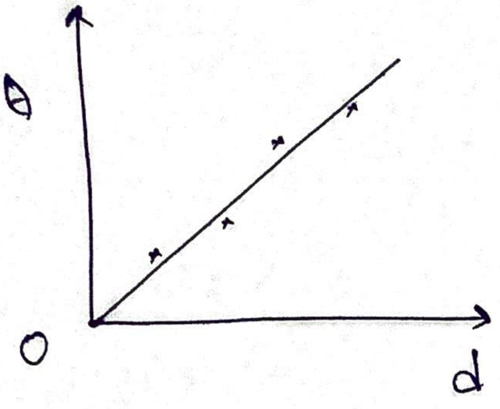
d → no. of grams of active substance per cc.

l → length of the light path in cm.

θ → angle of rotation.

Measuring the various θ values for diff. concentration of the active liquid, a straight line graph can be drawn, that passes through the origin.

The slope of the graph, $m = \frac{S \cdot l}{10}$, would give the value of S for a fixed l value.



Knowing the specific rotation & measuring the amount of rotation for a given soln. of the same substance, the concentration of the soln. can be determined.

→ In general, the rotation in liquids is considerably less than in crystals.

For turpentine, it rotates sodium light by -37° while travelling through 10 cm, whereas, a 10 cm thick quartz crystal rotates the Na light by 2172°.

→ The specific rotation of ~~qu~~ crystals are ~~dus~~ defined for an angular rotation for 1 mm light path.

→ Similar to crystals, the active solutions also give rise to rotatory dispersion.