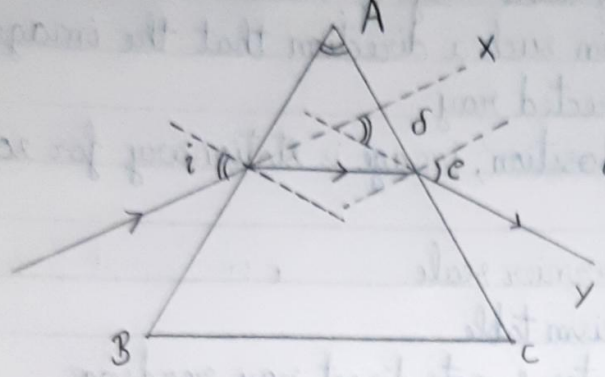
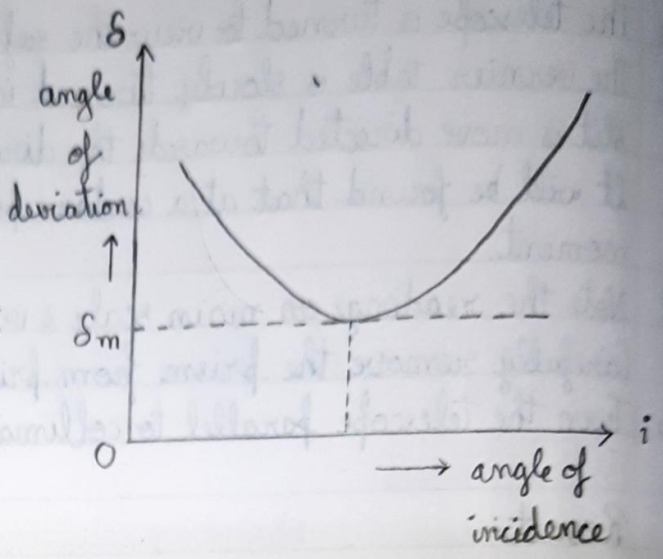
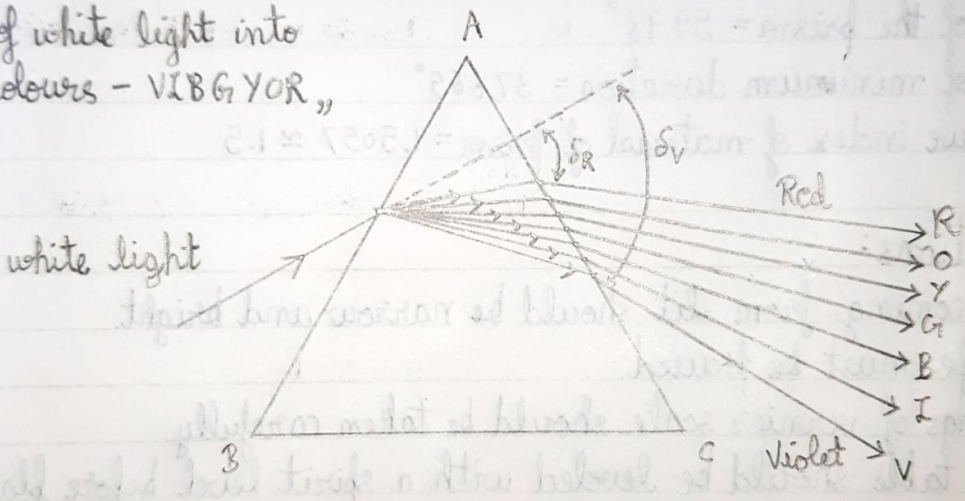
„ Deviation through prism

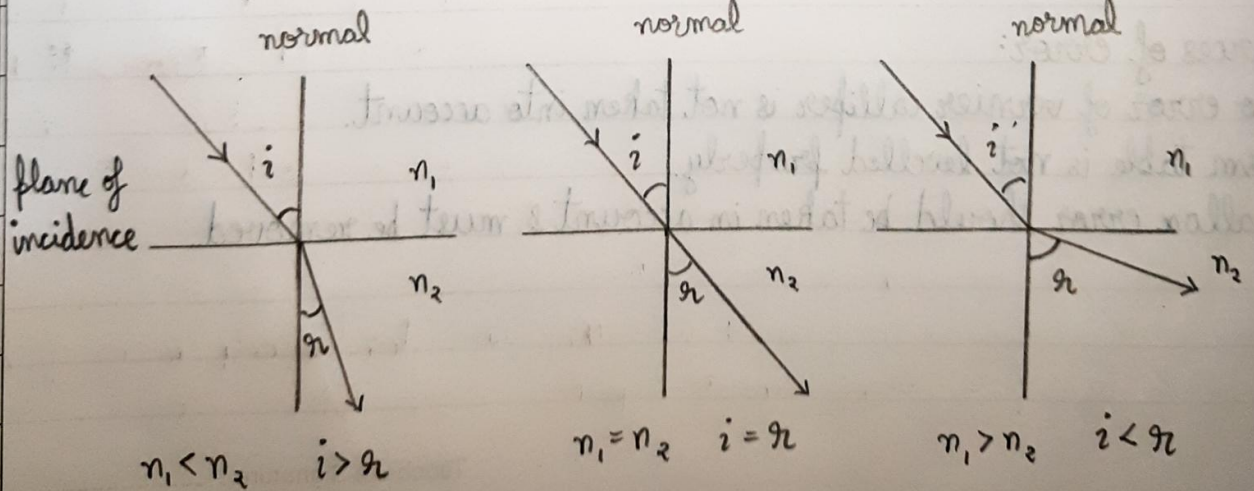


„ Graph b/w δ & i



Separation of white light into component colours - VIBGYOR „





Experiment 3.

Aim:

To determine the dispersive power of prism.

Apparatus required:

Spectrometer, prism, prism clamp, mercury vapour lamp, lens.

Formula used:

The formula for obtaining dispersive power of prism is,

$$\omega = \frac{\mu_v - \mu_r}{\mu_y - 1}$$

Here, μ_v is refractive index of prism corresponding to violet colour light. Similarly, μ_r and μ_y are corresponding to red & yellow colour lights.

Theory:

The refractive index of the material of the prism can be calculated by,,

$$\mu = \frac{\sin\left[\frac{A+\delta_m}{2}\right]}{\sin\left[\frac{A}{2}\right]}$$,,

where, δ_m is angle of minimum deviation

A is the angle of prism.

Upon passage through the prism, the white light is separated into its component colours - VIBGYOR. The separation of visible light into its different colours is known as dispersion.

Teacher's Signature : ----------

Observation table:

Line	Vernier	Refracted ray			Direct readings			Difference δ'_m	Mean, δ_m
		MSR	VSR	Total	MSR	VSR	Total		
Violet	V_1	70	0	70	110	20	110.3334	40.3334	40.25835°
	V_2	249.5	29	249.9834	290	10	290.1667	40.1833	
Yellow	V_1	70.5	18	70.8	110	20	110.3334	39.5334	39.53335°
	V_2	250.5	8	250.6334	290	10	290.1667	39.5333	
Red	V_1	71	23	71.3834	110	20	110.3334	38.95	38.9495°
	V_2	251	13	251.2167	290	10	290.1667	38.949	

Calculations:

Angle of the prism, $A = 59.98^\circ$

Angle of min. deviation, $\delta_v = 40.25835^\circ$

$\delta_y = 39.53335^\circ$

$\delta_r = 38.9495^\circ$

$$\mu_v = \frac{\sin\left[\frac{40.25835 + 59.98}{2}\right]^\circ}{\sin\left[\frac{59.98}{2}\right]^\circ} = \frac{\sin(50.119175^\circ)}{\sin(29.99^\circ)} = 1.5352237$$

$$\mu_y = \frac{\sin\left[\frac{39.53335 + 59.98}{2}\right]^\circ}{\sin\left[\frac{59.98}{2}\right]^\circ} = \frac{\sin(49.756675^\circ)}{\sin(29.99^\circ)} = 1.527$$

$$\mu_r = \frac{\sin\left[\frac{38.9495 + 59.98}{2}\right]^\circ}{\sin\left[\frac{59.98}{2}\right]^\circ} = \frac{\sin(49.46475^\circ)}{\sin(29.99^\circ)} = 1.52047219$$

The formula used for obtaining dispersive power of prism is,

$$\omega = \frac{\mu_v - \mu_r}{\mu_y - 1}$$

where, μ_v is refractive index of prism corresponding to violet colour light. similarly, μ_r & μ_y are corresponding to red & yellow colour lights.

Least count of spectrometer:

One main scale division (N) = 0.5° = 30 minutes

Number of divisions on vernier (V) = 30

Least count (LC) = $\frac{N}{V} = \frac{30'}{30}$ = 1 minute

Procedure:

1. Determine the least count of spectrometer.
2. Set the telescope by focusing on distant object.
3. Determine angle of prism.
4. Rotate vernier table so that different components of light from collimator falling on one of the face of prism & emerges through other face.
5. The telescope is turned to view the refracted images of different coloured slits on other face.
6. The vernier table is slowly turned in such a direction that the images of slits is move directed towards the directed ray.
7. It will be found that at a certain position, images are stationary for a colour for some moment.
8. Note the readings on main scale & vernier scale for violet, red & yellow.
9. Carefully remove the prism from prism table.
10. Turn the telescope parallel to collimator & note direct ray readings.

$\mu_v = 1.5352237$

$\mu_y = 1.527$

$\mu_r = 1.52047219$

Dispersive power, $\omega = \frac{\mu_v - \mu_r}{\mu_y - 1} = \frac{1.5352237 - 1.52047219}{1.527 - 1}$

$\omega = \frac{0.01475}{0.527} = 0.027988$

$\omega \simeq 0.028$

Dispersive power of prism is 0.028.

Result:

Angle of the prism = 59.98°

Dispersive power of prism = 0.027988 ≃ 0.028

Precautions & Sources of error:

1. Light coming from slit should be narrow and bright.
2. Telescope must be focused.
3. Readings of vernier scale should be taken carefully.
4. Zero error of vernier scale must be taken into account.
5. Prism table should be levelled with a spirit level before placing prism.