Date 18-02-2022

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"Diffraction Grating"

Objective :- To determine the wavelength of prominent lines of mercury by a plane diffraction grating.

Apparatus used :- A diffraction grating, spectrometer, mercury lamp, lens.

Formula used :- The wave length of a spectral line is given by

$$\lambda = \frac{[(e+d)\sin\theta]}{n}$$

where e+d is grating element = 2.54/N cm
N = no. of lines per inch on grating = 15000
θ = angle of diffraction
n = order of spectrum.

Procedure :- ① Switch on the mercury lamp.
② Mount the diffraction grating on Table.
③ Collimator and telescope are arranged in a line so that a bright white line is observed (called as direct Image.)

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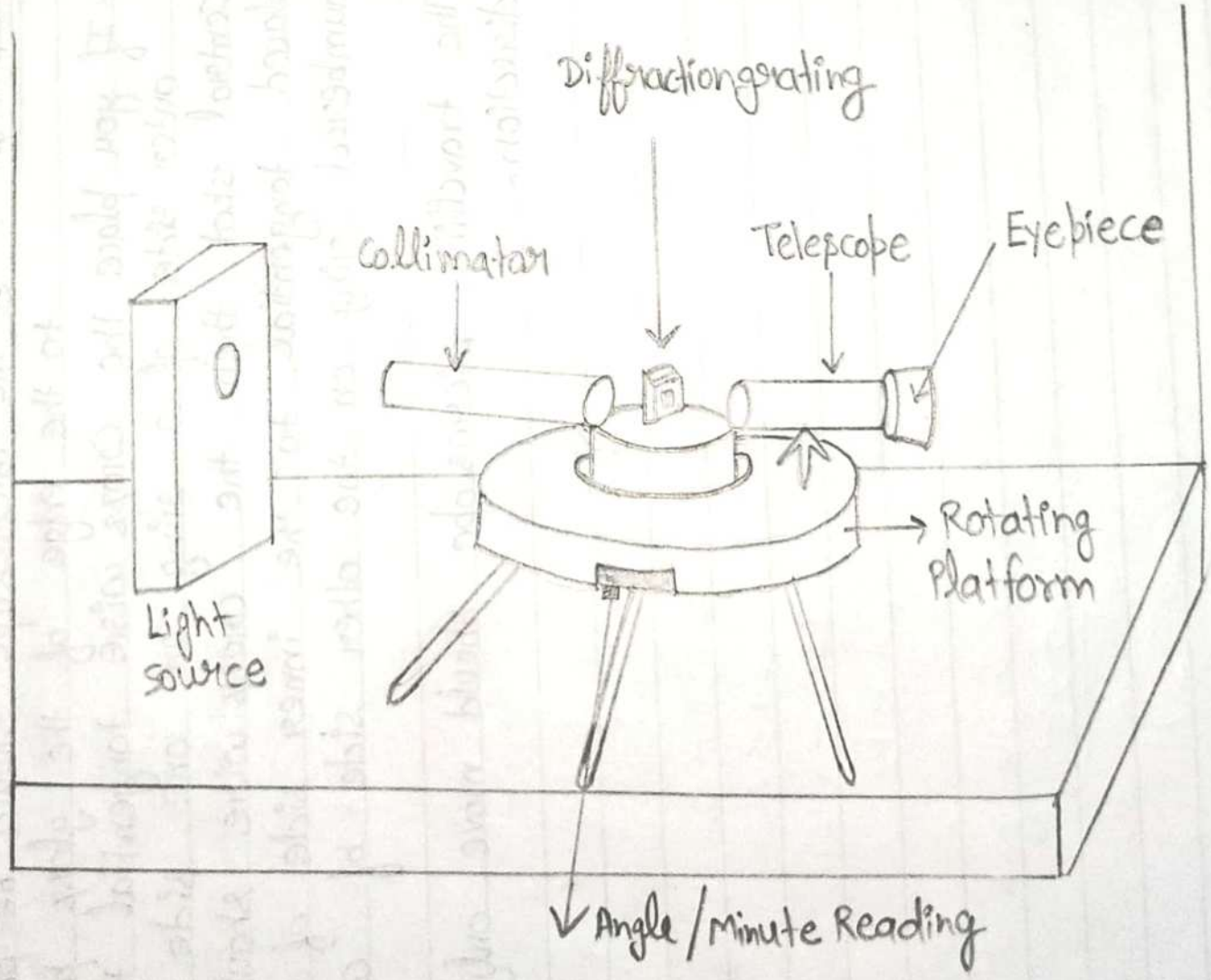
④ Adjust the collimator and width of the slit such that the direct Image become very sharp and bright.

⑤ Move the telescope to the left side of the direct Image beyond the red line of the 1st order spectrum and from this position rotate back slowly and adjust the cross wire of the telescope on the red, yellow, green, blue. and violet lines in turn and simultaneously note down the readings of veniers V1 and V2.

⑥ Proceed similary on right side of the direct Image and adjust vertical cross wire on the Violet, blue, green, yellow and red lines in turn and note down the readings of veniers V1 and V2.



☐ Experiment to find wavelength of prominent spectral lines of Mercury.

Observation Table :-

S.No	Colour of the spectral line	Vernier	Reading of telescope for a particular colour on						difference $2\theta = (a-b)$ (in degree)	mean (θ) (in degree)	$\sin\theta$
			left side of the direct image			right side of the direct image					
			MS	VS	Total 'a' (in degree)	MS	VS	Total 'b' (in degree)			
1	Violet	V_1	91.5	1	91.52	61	5	61.08	30.44	15.33	0.264
		V_2	271.5	29	272	241	7	241.12	30.88		
2	Green	V_1	93.5	5	93.85	57.5	11	57.69	36.16	17.23	0.296
		V_2	270.5	1	270.52	237.5	15	237.75	32.77		
3	yellow	V_1	96.5	13	96.72	56	4	56.07	40.65	20.34	0.347
		V_2	276.5	15	276.75	236	3	236.05	40.70		

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Calculation :-

$(e+d) = \frac{2.54}{N}$ cm $= \frac{2.54}{15000}$ cm $= 1.69 \times 10^{-4}$ cm

$(e+d) = 1.69 \times 10^{-6}$ m. and $n = 1$.

For Violet Colour :-

$$\lambda_V = \frac{(e+d)\sin\theta}{n} = \frac{1.69 \times 10^{-6} \times 0.264}{1} = 4.4616 \times 10^{-7} \text{ m}$$

or $\boxed{\lambda_V = 446.16 \text{ nm}}$

For Green Colour :-

$$\lambda_G = \frac{(e+d)\sin\theta}{n} = \frac{1.69 \times 10^{-6} \times 0.296}{1} = 5.0024 \times 10^{-7} \text{ m}$$

or $\boxed{\lambda_G = 500.24 \text{ nm}}$

For yellow Colour :-

$$\lambda_Y = \frac{(e+d)\sin\theta}{n} = \frac{1.69 \times 10^{-6} \times 0.347}{1} = 5.8643 \times 10^{-7} \text{ m}$$

or $\boxed{\lambda_Y = 586.43 \text{ nm}}$

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Result :- ① wavelength of violet colour light is 446.16 nm
② wave length of Green colour light is 500.24nm
③ wave length of yellow colour light is 586.43nm

Precautions and Source of Error :-

① slit should be narrow as possible.
② Grating should be set normal to incident light.
③ while taking observation, telescope and prism table should be kept fixed.
④ Read the values from both verniers carefully.