Table 2

Determination of the angles of diffraction for the lines of different colour and order

Order No. (n)	Colour of the line	Vernier No.	Left: Main scale (M)	Left: Vernier (V)	Left: Total (T=M+V)	Right: Main scale (M)	Right: Vernier (V)	Right: Total (T=M+V)	Difference between the left and right readings of vernier (2θ)	Mean (2θ) $(\frac{a+b}{2})$	Angle of Diffraction (θ)
1	Blue	1st	112° 20′	40	112° 33′ 20″ (= a_1)	107° 20′	36	107° 32′ (= a_2)	5° 1′ 20″ ($a_1 \sim a_2$) (=a)	4° 53′ 10″	2° 26′ 35″
		2nd	292° 20′	40	292° 33′ 20″ (= b_1)	287° 40′	25	287° 48′ 20″ (= b_2)	4° 45′ ($b_1 \sim b_2$) (=b)		
2		1st	115° 20′	56	115° 38′ 40″ (= a_1)	104° 40′	43	104° 54′ 20″ (= a_2)	10° 44′ 20″ ($a_1 \sim a_2$) (=a)	10° 33′ 20″	5° 16′ 40″
		2nd	295° 20′	37	295° 32′ 20″ (= b_1)	285°	30	285° 10′ 0″ (= b_2)	10° 22′ 20″ ($b_1 \sim b_2$) (=b)		

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Order No. (n)	Colour of the line	Vernier No.	Readings for the diffracted images with the telescope at the: Left			Right			Difference between the left and right readings of vernier (2θ)	Mean (2θ) $(\frac{a+b}{2})$	Angle of Diffraction (θ)
			Main scale (M)	Vernier (V)	Total (T=M+V)	Main scale (M)	Vernier (V)	Total (T=M+V)			
1	Green	1st	113°	5	113° 1′ 40″ (= a_1)	106° 40′	58	106° 59′ 20″ (= a_2)	6° 2′ 20″ (a_1 ~ a_2) (=a)	5° 59′ 10″	2° 59′ 35″
		2nd	293°	31	293° 10′ 20″ (= b_1)	287°	43	287° 14′ 20″ (= b_2)	5° 56′ 0″ (b_1~b_2) (=b)		
2		1st	116° 20′	15	116° 25′ (= a_1)	103° 40′	40	103° 53′ 20″ (= a_2)	12° 31′ 40″ (a_1 ~ a_2) (=a)	12° 34′ 10″	6° 17′ 5″
		2nd	296° 20′	35	296° 31′ 40″ (= b_1)	283° 40′	45	283° 55′ (= b_2)	12° 36′ 40″ (b_1~b_2) (=b)		

Order No. (n)	Colour of the line	Vernier No.	Readings for the diffracted images with the telescope at the						Difference between the left and right readings of vernier (2θ)	Mean (2θ) $(\frac{a+b}{2})$	Angle of Diffraction (θ)
			Left			Right					
			Main scale (M)	Vernier (V)	Total (T=M+V)	Main scale (M)	Vernier (V)	Total (T=M+V)			
1	Yellow	1st	113° 20′	2	113° 20′ 40″ (= a_1)	106° 40′	3	106° 41′ (= a_2)	6° 39′ 40″ ($a_1 \sim a_2$) (=a)	6° 33′ 10″	3° 16′ 35″
		2nd	293° 20′	9	293° 23′ (=b_1)	286° 40′	49	286° 56′ 20″ (=b_2)	6° 26′ 40″ ($b_1 \sim b_2$) (=b)		
2		1st	116° 40′	15	116° 45′ (= a_1)	103° 20′	25	103° 28′ 20″ (= a_2)	13° 16′ 40″ ($a_1 \sim a_2$) (=a)	13° 17′ 20″	6° 38′ 40″
		2nd	296° 40′	13	296° 44′ 20″ (=b_1)	283° 20′	19	283° 26′ 20″ (=b_2)	13° 18′ 0″ ($b_1 \sim b_2$) (=b)		

Calculation and Results

Table 3

Determination of wavelength of unknown lines

No. of lines per cm of the grating surface (N) (given)	Colour of the line	Order no. (n)	Angle of diffraction (θ) (From Table 2)	Wavelength of the spectral line(λ) (Å)	Mean λ (Å)
984	Blue	1	2° 26' 35"	4330.8	4501.8
		2	5° 16' 40"	4672.8	
	Green	1	2° 59' 35"	5305	5433
		2	6° 17' 5"	5561	
	Yellow	1	3° 16' 35"	5806.7	5842.3
		2	6° 38' 40"	5877.9	

Table 4

Determination of Resolving power and dispersive power of the grating

Colour of the line	Order No. (n)	Angle of diffraction θ (from Table 2)	No. of grating lines illuminated by the collimator (N)	Resolving power of the grating = nN	Angular dispersion of the grating = $\frac{nN}{2.54\cos\theta}$
Blue	1	2° 26' 35"	2500	2500	985.147
	2	5° 16' 40"	2500	5000	1976.885
Green	1	2° 59' 35"	2500	2500	985.596
	2	6° 17' 5"	2500	5000	1980.406
Yellow	1	3° 16' 35"	2500	2500	985.863
	2	6° 38' 40"	2500	5000	1981.815

Error calculation:

The wavelength of unknown spectral line is determined from the relation:

$$\lambda = \frac{\sin\theta}{nN}$$

Therefore, the maximum proportional error in the determination of λ is

$$\frac{\delta\lambda}{\lambda} = \frac{\cos\theta\ \delta\theta}{\sin\theta}$$

$$\frac{\delta\lambda}{\lambda} = \frac{\delta\theta}{\tan\theta} \quad \ldots(A)$$

2θ measured from the difference between two readings corresponding to two positions of the telescope. Hence $\delta\theta$ is equal to the value of one vernier constant (in radian). Substituting the measured values of θ and the value of $\delta\theta$ in eqn. (A) and multiplying by 100, the maximum percentage error in λ can be calculated. $\delta\theta = 96.96 \times 10^{-6}$

Maximum percentage error in value of λ in different cases:

Blue

1st Order : $\frac{\delta\lambda}{\lambda} \times 100 = \frac{96.96 \times 10^{-6} \times 100}{0.043} = 0.227\%$

2nd Order : $\frac{\delta\lambda}{\lambda} \times 100 = \frac{96.96 \times 10^{-6} \times 100}{0.092} = 0.105\%$

Green

1st Order : $\frac{\delta\lambda}{\lambda} \times 100 = \frac{96.96 \times 10^{-6} \times 100}{0.052} = 0.185\%$

2nd Order : $\frac{d\lambda}{\lambda} \times 100 = \frac{96.96 \times 10^{-6} \times 100}{0.110} = 0.088\%$

Yellow

1st Order : $\frac{d\lambda}{\lambda} \times 100 = \frac{96.96 \times 10^{-6} \times 100}{0.057} = 0.169\%$

2nd Order : $\frac{d\lambda}{\lambda} \times 100 = \frac{96.96 \times 10^{-6} \times 100}{0.116} = 0.083\%$