

60. Specific Rotation

Table 60-1. SPECIFIC ROTATION*
Solids

Substance	Wave-length, μm	Rota-tion, deg/min	Substance	Wave-length, μm	Rota-tion, deg/min
Cinnabar (HgS).....	<i>D</i>	+32.5	Quartz.....	0.3726	+58.894
Lead hyposulfate.....	<i>D</i>	5.5		0.3609	63.628
Potassium hyposulfate..	<i>D</i>	8.4		0.3582	64.459
Quartz.....	3.676	0.34		0.3466	69.454
	1.342	3.89		0.3441	70.587
	0.7604	12.668		0.3402	72.448
	0.7184	14.304		0.3360	74.571
	0.6867	15.746		0.3286	78.579
	0.6562	17.318		0.3247	80.459
	0.5895932	21.7010		0.3180	84.972
	0.5895	21.684		0.2747	121.052
	0.5892617	21.729		0.2571	143.266
	0.5889965	21.7492		0.2313	190.426
	0.5889	21.727		0.2265	201.824
	0.5460741	25.538		0.2194	220.731
	0.5269	27.543		0.21740	229.96
	0.4861	32.773		0.2143	235.972
	0.4307	42.604		0.1750	453.5
	0.4101	47.481		0.1525	776.0
	0.3968	51.193	Sodium bromate..	<i>D</i>	2.8
	0.3933	52.155	Sodium chlorate..	<i>D</i>	3.13
	0.3820	55.625			

Specific rotation or rotatory power is given in degrees per decimeter for liquids and solutions and in degrees per millimeter for solids; + signifies right-handed rotation, - left. Specific rotation varies with the wavelength of light used, with temperature and, in the case of solutions, with the concentration. When sodium light is used, indicated by *D* in the wavelength column, a value of $\lambda = 0.5893$ may be assumed.

Optical rotatory power for a large number of organic compounds will be found in the "International Critical Tables," vol. VII; for sugars, vol. II.

*Most of the data taken from "Handbook of Chemistry and Physics," 36th ed., pp. 2752, 2753, 2754, Chemical Rubber Publishing Company, 1954-1955.

TABLE 60-1. SPECIFIC ROTATION (Continued)
Liquid

Liquid	Temp., °C	Wave- length, μm	Specific rotation, deg/dm
Amyl alcohol.....	<i>D</i>	- 5.7
Camphor.....	20.4	<i>D</i>	+ 70.33
Cedar oil.....	15	<i>D</i>	- 30 to -40
Citron oil.....	15	<i>D</i>	+ 62
Ethyl malate (C ₂ H ₅) ₂ C ₄ H ₄ O ₆	11	<i>D</i>	- 10.3 to -12.4
Menthol.....	35.2	<i>D</i>	-49.7
Nicotine C ₁₀ H ₁₄ N ₂	10-30	<i>D</i>	-162
	20	0.6563	-126
	20	0.5351	-207.5
	20	0.4861	-253.5
Turpentine C ₁₀ H ₈	20	<i>D</i>	- 37
	20	0.6563	- 29.5
	20	0.5351	- 45
	20	0.4861	- 54.5

Specific rotation or rotatory power is given in degrees per decimeter for liquids and solutions and in degrees per millimeter for solids; + signifies right-handed rotation, - left. Specific rotation varies with the wavelength of light used, with temperature and, in the case of solutions, with the concentration. When sodium light is used, indicated by *D* in the wavelength column, a value of $\lambda = 0.5893$ may be assumed.

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TABLE 60-1. SPECIFIC ROTATION* (Continued)
Solutions†

Substance	Solvent	Temp., °C	Wave-length, μm	Specific rotation, deg/dm	Correction for concentration or temp.
Albumen.....	Water	...	<i>D</i>	- 25 to -38	
Arabinose.....	Water	20	<i>D</i>	- 105.0	
Campher.....	Alcohol	20	<i>D</i>	+ 54.4 - 0.135 <i>d</i> for <i>d</i> = 45-91	
	Benzene	20	<i>D</i>	+ 56 - 0.166 <i>d</i> for <i>d</i> = 47-90	
	Ether	...	<i>D</i>	+ 57	
Dextrose- <i>d</i> -glucose $\text{C}_6\text{H}_{12}\text{O}_6$	Water	20	<i>D</i>	+ 52.5 + 0.025 <i>d</i> for <i>d</i> = 1-18	
			0.5461	+ 62.03 + 0.04257 <i>c</i> for <i>c</i> = 6-32	
Galactose.....	Water	...	<i>D</i>	+ 83.9 + 0.078 <i>d</i> - 0.21 <i>t</i> for <i>d</i> = 4-36 and <i>t</i> = 10-30°C	
<i>l</i> -Glucose (β).....	Water	20	<i>D</i>	- 51.4	
Invert sugar $\text{C}_6\text{H}_{12}\text{O}_6$...	Water	20	<i>D</i>	- 19.7 - 0.036 <i>c</i> for <i>c</i> = 9-35	
				$\alpha_t = \alpha_{20} + 0.304(t - 20)$ + 0.00165 $(t - 20)^2$ for <i>t</i> = 3-30°C	
		25	0.5461	- 21.5	
Lactose.....	Water	20	<i>D</i>	+ 52.4 + 0.072 (20° - <i>t</i>) for <i>c</i> = 5	
			0.5461	+ 61.9 + 0.085 (20° - <i>t</i>) for <i>c</i> = 5	
Levulose fruit sugar....	Water	25	<i>D</i>	- 88.5 - 0.145 <i>d</i> for <i>d</i> = 2.6-18.6	
			0.5461	- 105.30	
Maltose.....	Water	20	<i>D</i>	+ 138.48 - 0.01837 <i>d</i> for <i>d</i> = 5-35	
			0.5461	+ 153.75	
Mannose.....	Water	20	<i>D</i>	+ 14.1 <i>c</i> = 10.2	
Nicotine.....	Water	20	<i>D</i>	- 77 for <i>d</i> = 1-16	
	Benzene	20	<i>D</i>	- 164 for <i>d</i> = 8-100	
Potassium tartrate.....	Water	20	<i>D</i>	+ 27.14 + 0.0992 <i>c</i> - 0.00094 <i>c</i> ² for <i>c</i> = 8-50	
	Water	17	<i>D</i>	- 214	
Quinine sulfate.....	Water	17	<i>D</i>	- 214	
Santonin.....	Alcohol	20	<i>D</i>	- 161.0 <i>c</i> = 1.78	
		20	<i>D</i>	+ 693 <i>c</i> = 4.05	
	Chloroform	20	<i>D</i>	- 202.7 + 0.309 <i>d</i> for <i>d</i> = 75-96.5	
	Alcohol	20	0.6867	+ 442 <i>c</i> = 4.05	
			0.5269	+ 991 <i>c</i> = 4.05	
			0.4861	+1,323 <i>c</i> = 4.05	

† Corrections for values of the specific rotation for concentration are given in the last column. *c* indicates concentration in grams per 100 ml of solution; *d* indicates the concentration in grams per 100 g of solution.

TABLE 60-1. SPECIFIC ROTATION (Continued)

Solutions†

Substance	Solvent	Temp., °C	Wave-length, μm	Specific rotation, deg/dm	Correction for concentration or temp.
Sodium potassium tartrate (rochelle salt)	Water	20	<i>D</i>	+ 29.75	- 0.0078 <i>c</i>
Sucrose (cane sugar) $\text{C}_{12}\text{H}_{22}\text{O}_{11}$	Water	20	<i>D</i>	+ 66.412	+ 0.01267 <i>d</i> - 0.000376 <i>d</i> ² for <i>d</i> = 0-50 $\alpha_t = \alpha_{20}[1 - 0.00037(t - 20)]$ for <i>t</i> = 14-30°C

Solutions†

Sucrose dissolved in water, 20°C

μm	Spec. rot.	μm	Spec. rot.	μm	Spec. rot.
670.8 (Li)	+50.51	510.6 (Cu)	+90.46	435.3 (Fe)	+128.5
643.8 (Cd)	55.04	508.6 (Cd)	91.16	433.7 (Fe)	129.8
636.2 (Zn)	56.51	481.1 (Zn)	103.07	431.5 (Fe)	130.7
589.3 (Na)	66.45	480.0 (Cd)	103.62	428.2 (Fe)	133.6
578.2 (Cu)	69.10	472.2 (Zn)	107.38	427.2 (Fe)	134.2
578.0 (Hg)	69.22	468.0 (Zn)	109.49	426.1 (Fe)	134.9
570.0 (Cu)	71.24	467.8 (Cd)	109.69	419.1 (Fe)	140.0
546.1 (Hg)	78.10	438.4 (Fe)	126.5	414.4 (Fe)	144.2
521.8 (Cu)	86.21	437.6 (Fe)	127.2	388.9 (Fe)	166.7
515.3 (Cu)	88.68	435.8 (Hg)	128.49	383.3 (Fe)	171.8
				382.6 (Fe)	173.1

Solutions†

Substance	Solvent	°C	μm	Spec. rot.	Correction
Tartaric acid (ord.).....	Water	20	<i>D</i>	+15.06	- 0.131 <i>c</i>
		20	0.6563	7.75	} for <i>d</i> = 41
		20	<i>D</i>	8.86	
		20	0.5351	9.65	
		20	0.4861	9.37	
Turpentine.....	Alcohol	20	<i>D</i>	-37	- 0.00482 <i>d</i> - 0.00013 <i>d</i> ² for <i>d</i> = 0-90
		20	<i>D</i>	-37	- 0.0265 <i>d</i> for <i>d</i> = 0-91
Xylose.....	Water	20	<i>D</i>	+19.13	<i>d</i> = 2.7

† Corrections for values of the specific rotation for concentration are given in the last column. *c* indicates concentration in grams per 100 ml of solution; *d* indicates the concentration in grams per 100 g of solution.