极-直坐标

换算手册

国营青云仪器厂

北　京

前　言

在党的“十大”团结、胜利路线的指引下，我国各条战线生气勃勃，蒸蒸日上。我们工人阶级在毛主席提出的“工业学大庆”的伟大号召下，抓革命、促生产、促工作、促战备不断取得新的伟大胜利。在生产实践过程中，特别是群众性的技术革新运动蓬勃开展，经常遇到带角度的尺寸换算问题，根据广大工人和技术人员的实际需要，我们采用“三结合”方法在短期内编写了这本“极-直坐标换算手册”。它不仅为工人，技术人员在机械设计、工艺规程编制、机械加工和编制电子和射流程序等方面，提供了节省时间的工具，而且提高了换算的准确性，

由于我们首次编写此类手册，难免有不妥之处，望同志们提出宝贵意见。

国营青云仪器厂技术情报室

1973年10月

使 用 说 明

本手册中所列数据是按下列公式：

$$x = R \cdot \cos\alpha$$

$$y = R \cdot \sin\alpha 。$$

用八位三角函数表计算的，将计算结果用四舍五入法化整到小数点后面四位数。

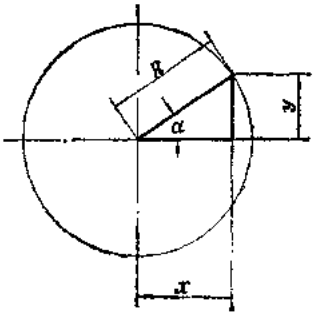
公式中各参数如右图所示：

R ——斜边，即圆的半径；

α ——圆心角；

x ——$\angle\alpha$ 的邻边；

y ——$\angle\alpha$ 的对边。



本手册使用方法：

（一）本手册可以直接查得半径 R10～99，圆心角为0°15′～89°45′（间隔：15′）一一相应的直线尺寸。

例：已知 $R=80$，$\alpha=20°$，求 x，y。

查表可得：半径 $R=80$，

$$x = 75.1754;$$

$$y = 27.3616。$$

（二）当半径 R 小于10时：

1．当半径 R 为小于10的整数时，如 $R=2$，可按照 $R=20$（即 $A\times 10$）去查表得 $x=a_1$，$y=b_1$，然后将 a_1 和 b_1 分别缩小10倍即为所求的 x，y。

例：已知 $R=2$，$\alpha=20^{\circ}$，求 x_1，y_1。

按 $R=20$ 查表得：

$$x=18.7939;$$

$$y=6.8404。$$

则 $R=2$ 时　　$x_1=1.8794$

$$y_1=0.6840。$$

2．当半径 R 为小于 10 的小数 B 时。如 $R=0.2$，可按照 $R=20$（即 $B\times100$）去查表得 $x_2'=a_2$，$y_2'=b_2$ 然后将 a_2 和 b_2 分别缩小 100 倍，即为所求的 x_2 和 y_2。

例：已知 $R=0.2$，$\alpha=20^{\circ}$ 求 x_2，y_2

按 $R=20$ 查表得：

$$x=18.7939;$$

$$y=6.8404。$$

则 $R=0.2$ 时，　$x_2=0.1879$

$$y_2=0.0684。$$

（三）当半径 R 大于 99 时：

1．当半径 R 为大于 99 的整数 A' 时。如 $R=110$，可按照 $R=11$（即 $A'\times\frac{1}{10}$）去查表得 $x_3'=a_3$，$y_3'=b_3$ 然后将 a_3 和 b_3 分别乘以 10 倍，即为所求的 x_3 和 y_3。

例：已知 $R=110$，$\alpha=20^{\circ}$，求 x_3，y_3。

按 $R=11$ 查表得：

$$x=10.3366;$$

$$y=3.7622。$$

则 $R=110$ 时；$x_3=103.366$，

$$y_3=37.622。$$

2．当半径R为大于99的带小数的整数B'时。如$R=110.2$，(即110+0.2)，可按照上述求110和0.2的方法分别求出x'_4和x'_5；y'_6和y'_7。然后分别求出它们的和x_4和y_4。

例五：已知$R=110.2$，$\alpha=20°$，求x_4，y_4。

由上两例知$R=110.2$时，

$$x'_4=x_3=103.366;$$

$$x'_5=x_2=0.1879。$$

$$y'_6=y_3=37.622;$$

$$y'_7=y_2=0.0684。$$

因此 $x_4=x'_4+x'_5=103.366+0.1879=103.5539;$

$y_4=y'_6+y'_7=37.622+0.0684=37.6904。$

由此可见，在通常实际计算中，只要掌握了此表的使用方法，大量的数可直接查得。有一些数只要查两次或三次表求出它们的和即可。所需要查表的次数可根据半径R的整数或小数位数而定。

《极一直坐标换算手册》勘误表

页次	度　数	R	坐标	误	正
18	4° 30′	40	x	39.8667	39.8767
21	5° 15′	90	y	8.2361	8.2351
93	23° 15′	80	y	31.5995	31.5795
附表4	页			求 $\alpha=7°\ 30$	求 $\alpha=7°\ 30'$

0°15′

R	x	y	R	x	y	R	x	y
10	9.9999	0.0436	40	39.9996	0.1745	70	69.9993	0.3054
11	10.9999	0.0480	41	40.9996	0.1789	71	70.9993	0.3098
12	11.9999	0.0524	42	41.9996	0.1833	72	71.9993	0.3142
13	12.9999	0.0567	43	42.9996	0.1876	73	72.9993	0.3185
14	13.9999	0.0611	44	43.9996	0.1920	74	73.9993	0.3229
15	14.9999	0.0654	45	44.9996	0.1963	75	74.9993	0.3272
16	15.9998	0.0698	46	45.9996	0.2007	76	75.9993	0.3316
17	16.9998	0.0742	47	46.9996	0.2051	77	76.9993	0.3360
18	17.9998	0.0785	48	47.9995	0.2094	78	77.9993	0.3403
19	18.9998	0.0829	49	48.9995	0.2138	79	78.9992	0.3447
20	19.9998	0.0873	50	49.9995	0.2182	80	79.9992	0.3491
21	20.9998	0.0916	51	50.9995	0.2225	81	80.9992	0.3534
22	21.9998	0.0960	52	51.9995	0.2269	82	81.9992	0.3578
23	22.9998	0.1004	53	52.9995	0.2313	83	82.9992	0.3622
24	23.9998	0.1047	54	53.9995	0.2356	84	83.9992	0.3665
25	24.9998	0.1091	55	54.9995	0.2400	85	84.9992	0.3709
26	25.9998	0.1134	56	55.9995	0.2443	86	85.9992	0.3752
27	26.9997	0.1178	57	56.9995	0.2487	87	86.9992	0.3796
28	27.9997	0.1222	58	57.9994	0.2530	88	87.9992	0.3840
29	28.9997	0.1265	59	58.9994	0.2574	89	88.9992	0.3883
30	29.9997	0.1310	60	59.9994	0.2618	90	89.9991	0.3927
31	30.9997	0.1353	61	60.9994	0.2662	91	90.9991	0.3971
32	31.9997	0.1396	62	61.9994	0.2705	92	91.9991	0.4014
33	32.9997	0.1440	63	62.9994	0.2749	93	92.9991	0.4058
34	33.9997	0.1484	64	63.9994	0.2793	94	93.9991	0.4102
35	34.9997	0.1527	65	64.9994	0.2836	95	94.9991	0.4145
36	35.9997	0.1571	66	65.9994	0.2880	96	95.9991	0.4189
37	36.9996	0.1614	67	66.9994	0.2923	97	96.9991	0.4232
38	37.9996	0.1658	68	67.9994	0.2967	98	97.9991	0.4276
39	38.9996	0.1702	69	68.9993	0.3011	99	98.9991	0.4320
R	y	x	R	y	x	R	y	x

89°45′

0°30′

R	x	y	R	x	y	R	x	y
10	9.9996	0.0873	40	39.9985	0.3491	70	69.9973	0.6109
11	10.9996	0.0960	41	40.9984	0.3578	71	70.9973	0.6196
12	11.9995	0.1047	42	41.9984	0.3665	72	71.9973	0.6283
13	12.9995	0.1134	43	42.9984	0.3752	73	72.9972	0.6370
14	13.9995	0.1222	44	43.9983	0.3840	74	73.9972	0.6458
15	14.9994	0.1309	45	44.9983	0.3927	75	74.9971	0.6545
16	15.9994	0.1396	46	45.9982	0.4014	76	75.9971	0.6632
17	16.9994	0.1484	47	46.9982	0.4101	77	76.9971	0.6719
18	17.9993	0.1571	48	47.9982	0.4189	78	77.9970	0.6807
19	18.9993	0.1658	49	48.9981	0.4276	79	78.9970	0.6894
20	19.9992	0.1745	50	49.9981	0.4363	80	79.9970	0.6981
21	20.9992	0.1833	51	50.9981	0.4451	81	80.9969	0.7068
22	21.9992	0.1920	52	51.9980	0.4538	82	81.9969	0.7156
23	22.9991	0.2007	53	52.9980	0.4625	83	82.9968	0.7243
24	23.9991	0.2094	54	53.9979	0.4712	84	83.9968	0.7330
25	24.9990	0.2182	55	54.9979	0.4800	85	84.9968	0.7418
26	25.9990	0.2269	56	55.9979	0.4887	86	85.9967	0.7505
27	26.9990	0.2356	57	56.9978	0.4974	87	86.9967	0.7592
28	27.9989	0.2443	58	57.9978	0.5061	88	87.9966	0.7679
29	28.9989	0.2531	59	58.9978	0.5149	89	88.9966	0.7767
30	29.9989	0.2618	60	59.9977	0.5236	90	89.9966	0.7854
31	30.9988	0.2705	61	60.9977	0.5323	91	90.9965	0.7941
32	31.9988	0.2792	62	61.9976	0.5410	92	91.9965	0.8028
33	32.9987	0.2880	63	62.9976	0.5498	93	92.9965	0.8116
34	33.9987	0.2967	64	63.9976	0.5585	94	93.9964	0.8203
35	34.9987	0.3054	65	64.9975	0.5672	95	94.9964	0.8290
36	35.9986	0.3142	66	65.9975	0.5760	96	95.9963	0.8377
37	36.9986	0.3229	67	66.9974	0.5847	97	96.9963	0.8465
38	37.9986	0.3316	68	67.9974	0.5934	98	97.9963	0.8552
39	38.9985	0.3403	69	68.9974	0.6021	99	98.9962	0.8639
R	y	x	R	y	x	R	y	x

89°30′

R	x	y	R	x	y	R	x	y
10	9.9991	0.1309	40	39.9966	0.5236	70	69.9940	0.9163
11	10.9990	0.1440	41	40.9965	0.5367	71	70.9939	0.9294
12	11.9990	0.1571	42	41.9964	0.5498	72	71.9938	0.9425
13	12.9989	0.1702	43	42.9963	0.5629	73	72.9937	0.9555
14	13.9988	0.1833	44	43.9962	0.5759	74	73.9937	0.9686
15	14.9987	0.1963	45	44.9961	0.5890	75	74.9936	0.9817
16	15.9986	0.2094	46	45.9961	0.6021	76	75.9935	0.9948
17	16.9985	0.2225	47	46.9960	0.6152	77	76.9934	1.0079
18	17.9985	0.2356	48	47.9959	0.6283	78	77.9933	1.0210
19	18.9984	0.2487	49	48.9958	0.6414	79	78.9932	1.0341
20	19.9983	0.2618	50	49.9957	0.6545	80	79.9931	1.0472
21	20.9982	0.2749	51	50.9956	0.6676	81	80.9930	1.0603
22	21.9981	0.2880	52	51.9955	0.6807	82	81.9929	1.0733
23	22.9980	0.3011	53	52.9955	0.6937	83	82.9928	1.0864
24	23.9979	0.3142	54	53.9954	0.7068	84	83.9928	1.0995
25	24.9979	0.3272	55	54.9953	0.7199	85	84.9927	1.1126
26	25.9978	0.3403	56	55.9952	0.7330	86	85.9926	1.1257
27	26.9977	0.3534	57	56.9951	0.7461	87	86.9925	1.1388
28	27.9976	0.3665	58	57.9950	0.7592	88	87.9925	1.1519
29	28.9975	0.3796	59	58.9949	0.7723	89	88.9924	1.1650
30	29.9974	0.3927	60	59.9949	0.7854	90	89.9923	1.1781
31	30.9973	0.4058	61	60.9948	0.7985	91	90.9922	1.1912
32	31.9973	0.4189	62	61.9947	0.8116	92	91.9921	1.2042
33	32.9972	0.4320	63	62.9946	0.8246	93	92.9920	1.2173
34	33.9971	0.4450	64	63.9945	0.8377	94	93.9919	1.2304
35	34.9970	0.4581	65	64.9944	0.8508	95	94.9918	1.2435
36	35.9969	0.4712	66	65.9943	0.8639	96	95.9917	1.2566
37	36.9968	0.4843	67	66.9943	0.8770	97	96.9916	1.2697
38	37.9967	0.4974	68	67.9942	0.8901	98	97.9916	1.2828
39	38.9967	0.5105	69	68.9941	0.9032	99	98.9915	1.2959
R	y	x	R	y	x	R	y	x

1°

R	x	y	R	x	y	R	x	y
10	9.9985	0.1745	40	39.9939	0.6981	70	69.9892	1.2217
11	10.9983	0.1920	41	40.9938	0.7155	71	70.9892	1.2391
12	11.9982	0.2094	42	41.9936	0.7330	72	71.9890	1.2566
13	12.9980	0.2269	43	42.9935	0.7505	73	72.9889	1.2740
14	13.9979	0.2443	44	43.9933	0.7679	74	73.9887	1.2915
15	14.9977	0.2618	45	44.9931	0.7854	75	74.9886	1.3089
16	15.9976	0.2792	46	45.9930	0.8028	76	75.9884	1.3264
17	16.9974	0.2967	47	46.9928	0.8203	77	76.9883	1.3438
18	17.9973	0.3141	48	47.9927	0.8377	78	77.9881	1.3613
19	18.9971	0.3316	49	48.9925	0.8552	79	78.9880	1.3787
20	19.9970	0.3490	50	49.9924	0.8726	80	79.9878	1.3962
21	20.9968	0.3665	51	50.9922	0.8901	81	80.9877	1.4136
22	21.9966	0.3840	52	51.9921	0.9075	82	81.9875	1.4311
23	22.9965	0.4014	53	52.9919	0.9250	83	82.9874	1.4486
24	23.9963	0.4189	54	53.9918	0.9424	84	83.9872	1.4660
25	24.9962	0.4363	55	54.9916	0.9599	85	84.9871	1.4835
26	25.9960	0.4538	56	55.9915	0.9773	86	85.9869	1.5009
27	26.9959	0.4712	57	56.9913	0.9948	87	86.9867	1.5184
28	27.9957	0.4887	58	57.9912	1.0122	88	87.9866	1.5358
29	28.9956	0.5061	59	58.9910	1.0297	89	88.9864	1.5533
30	29.9954	0.5236	60	59.9909	1.0471	90	89.9863	1.5707
31	30.9953	0.5410	61	60.9907	1.0646	91	90.9861	1.5882
32	31.9951	0.5585	62	61.9906	1.0820	92	91.9860	1.6056
33	32.9950	0.5759	63	62.9904	1.0995	93	92.9858	1.6231
34	33.9948	0.5934	64	63.9903	1.1170	94	93.9857	1.6405
35	34.9947	0.6108	65	64.9901	1.1344	95	94.9855	1.6580
36	35.9945	0.6283	66	65.9899	1.1519	96	95.9854	1.6754
37	36.9944	0.6457	67	66.9898	1.1693	97	96.9852	1.6929
38	37.9942	0.6632	68	67.9896	1.1868	98	97.9851	1.7103
39	38.9941	0.6806	69	68.9895	1.2042	99	98.9849	1.7278
R	y	x	R	y	x	R	y	x

89°

R	x	y	R	x	y	R	x	y
10	9.9976	0.2181	40	39.9905	0.8726	70	69.9833	1.5270
11	10.9974	0.2400	41	40.9902	0.8944	71	70.9831	1.5489
12	11.9971	0.2617	42	41.9900	0.9162	72	71.9829	1.5707
13	12.9969	0.2836	43	42.9898	0.9380	73	72.9826	1.5925
14	13.9967	0.3054	44	43.9895	0.9599	74	73.9824	1.6143
15	14.9964	0.3272	45	44.9893	0.9817	75	74.9822	1.6361
16	15.9962	0.3490	46	45.9891	1.0035	76	75.9819	1.6579
17	16.9960	0.3709	47	46.9888	1.0253	77	76.9817	1.6797
18	17.9957	0.3927	48	47.9886	1.0471	78	77.9814	1.7016
19	18.9955	0.4145	49	48.9883	1.0689	79	78.9812	1.7234
20	19.9952	0.4363	50	49.9881	1.0907	80	79.9810	1.7452
21	20.9950	0.4581	51	50.9879	1.1126	81	80.9807	1.7670
22	21.9948	0.4799	52	51.9876	1.1344	82	81.9805	1.7888
23	22.9945	0.5017	53	52.9874	1.1562	83	82.9802	1.8106
24	23.9943	0.5236	54	53.9871	1.1780	84	83.9800	1.8324
25	24.9941	0.5454	55	54.9869	1.1998	85	84.9798	1.8543
26	25.9938	0.5672	56	55.9867	1.2216	86	85.9795	1.8761
27	26.9936	0.5890	57	56.9864	1.2434	87	86.9793	1.8979
28	27.9933	0.6108	58	57.9862	1.2652	88	87.9791	1.9197
29	28.9931	0.6326	59	58.9860	1.2870	89	88.9788	1.9415
30	29.9929	0.6544	60	59.9857	1.3089	90	89.9786	1.9633
31	30.9926	0.6763	61	60.9855	1.3307	91	90.9783	1.9852
32	31.9924	0.6981	62	61.9852	1.3525	92	91.9781	2.0070
33	32.9921	0.7199	63	62.9850	1.3743	93	92.9779	2.0288
34	33.9919	0.7417	64	63.9848	1.3962	94	93.9776	2.0506
35	34.9917	0.7635	65	64.9845	1.4180	95	94.9774	2.0724
36	35.9914	0.7853	66	65.9843	1.4398	96	95.9772	2.0942
37	36.9912	0.8072	67	66.9841	1.4616	97	96.9769	2.1160
38	37.9910	0.8290	68	67.9838	1.4834	98	97.9767	2.1379
39	38.9907	0.8508	69	68.9836	1.5052	99	98.9764	2.1597
R	y	x	R	y	x	R	y	x

R	x	y	R	x	y	R	x	y
10	9.9966	0.2618	40	39.9863	1.0471	70	69.9760	1.8324
11	10.9962	0.2879	41	40.9860	1.0733	71	70.9757	1.8586
12	11.9959	0.3141	42	41.9856	1.0994	72	71.9753	1.8847
13	12.9955	0.3403	43	42.9853	1.1256	73	72.9750	1.9109
14	13.9952	0.3665	44	43.9849	1.1518	74	73.9746	1.9371
15	14.9949	0.3927	45	44.9846	1.1780	75	74.9743	1.9633
16	15.9945	0.4188	46	45.9842	1.2041	76	75.9740	1.9894
17	16.9942	0.4450	47	46.9839	1.2303	77	76.9736	2.0156
18	17.9938	0.4712	48	47.9836	1.2565	78	77.9733	2.0418
19	18.9935	0.4974	49	48.9832	1.2827	79	78.9729	2.0680
20	19.9931	0.5235	50	49.9829	1.3088	80	79.9726	2.0942
21	20.9928	0.5497	51	50.9825	1.3350	81	80.9722	2.1203
22	21.9925	0.5759	52	51.9822	1.3612	82	81.9719	2.1465
23	22.9921	0.6021	53	52.9818	1.3874	83	82.9716	2.1727
24	23.9918	0.6282	54	53.9815	1.4136	84	83.9712	2.1989
25	24.9914	0.6544	55	54.9812	1.4397	85	84.9709	2.2250
26	25.9911	0.6806	56	55.9808	1.4659	86	85.9705	2.2512
27	26.9907	0.7068	57	56.9805	1.4921	87	86.9702	2.2774
28	27.9904	0.7330	58	57.9801	1.5183	88	87.9698	2.3036
29	28.9901	0.7591	59	58.9798	1.5444	89	88.9695	2.3297
30	29.9897	0.7853	60	59.9794	1.5706	90	89.9692	2.3559
31	30.9894	0.8115	61	60.9791	1.5968	91	90.9688	2.3821
32	31.9890	0.8377	62	61.9788	1.6230	92	91.9685	2.4083
33	32.9887	0.8638	63	62.9784	1.6491	93	92.9681	2.4345
34	33.9883	0.8900	64	63.9781	1.6753	94	93.9678	2.4606
35	34.9880	0.9162	65	64.9777	1.7015	95	94.9674	2.4868
36	35.9877	0.9424	66	65.9774	1.7277	96	95.9671	2.5130
37	36.9873	0.9685	67	66.9770	1.7539	97	96.9668	2.5392
38	37.9870	0.9947	68	67.9767	1.7800	98	97.9664	2.5653
39	38.9866	1.0209	69	68.9764	1.8062	99	98.9661	2.5915
R	y	x	R	y	x	R	y	x

1°45′

R	x	y	R	x	y	R	x	y
10	9.9953	0.3051	40	39.9813	1.2214	70	69.9674	2.1377
11	10.9949	0.3359	41	40.9809	1.2521	71	70.9669	2.1682
12	11.9944	0.3665	42	41.9804	1.2826	72	71.9664	2.1988
13	12.9939	0.3970	43	42.9799	1.3132	73	72.9660	2.2293
14	13.9935	0.4275	44	43.9795	1.3437	74	73.9655	2.2598
15	14.9930	0.4581	45	44.9790	1.3742	75	74.9650	2.2904
16	15.9925	0.4886	46	45.9785	1.4048	76	75.9646	2.3209
17	16.9921	0.5192	47	46.9781	1.4353	77	76.9641	2.3515
18	17.9916	0.5497	48	47.9776	1.4658	78	77.9636	2.3820
19	18.9911	0.5802	49	48.9771	1.4964	79	78.9632	2.4125
20	19.9907	0.6108	50	49.9767	1.5270	80	79.9627	2.4431
21	20.9902	0.6413	51	50.9762	1.5575	81	80.9622	2.4736
22	21.9897	0.6718	52	51.9757	1.5880	82	81.9618	2.5042
23	22.9893	0.7024	53	52.9753	1.6185	83	82.9613	2.5347
24	23.9888	0.7329	54	53.9748	1.6491	84	83.9608	2.5652
25	24.9883	0.7635	55	54.9743	1.6796	85	84.9603	2.5958
26	25.9879	0.7940	56	55.9739	1.7102	86	85.9599	2.6263
27	26.9874	0.8245	57	56.9734	1.7407	87	86.9594	2.6569
28	27.9869	0.8551	58	57.9729	1.7712	88	87.9590	2.6874
29	28.9865	0.8856	59	58.9725	1.8018	89	88.9585	2.7179
30	29.9860	0.9162	60	59.9720	1.8323	90	89.9580	2.7485
31	30.9855	0.9467	61	60.9715	1.8628	91	90.9576	2.7790
32	31.9851	0.9772	62	61.9711	1.8934	92	91.9571	2.8095
33	32.9846	1.0078	63	62.9706	1.9239	93	92.9566	2.8401
34	33.9841	1.0383	64	63.9701	1.9545	94	93.9562	2.8706
35	34.9837	1.0688	65	64.9697	1.9850	95	94.9557	2.9012
36	35.9832	1.0994	66	65.9692	2.0155	96	95.9552	2.9317
37	36.9827	1.1299	67	66.9688	2.0461	97	96.9548	2.9622
38	37.9823	1.1605	68	67.9683	2.0766	98	97.9543	2.9928
39	38.9818	1.1910	69	68.9678	2.1072	99	98.9538	3.0233
R	y	x	R	y	x	R	y	x

88°15′

2°

R	x	y	R	x	y	R	x	y
10	9.9939	0.3490	40	39.9756	1.3960	70	69.9574	2.4430
11	10.9933	0.3839	41	40.9750	1.4309	71	70.9567	2.4779
12	11.9927	0.4188	42	41.9744	1.4658	72	71.9561	2.5128
13	12.9921	0.4537	43	42.9738	1.5007	73	72.9555	2.5477
14	13.9915	0.4886	44	43.9732	1.5356	74	73.9549	2.5826
15	14.9909	0.5235	45	44.9726	1.5705	75	74.9543	2.6175
16	15.9903	0.5584	46	45.9720	1.6054	76	75.9537	2.6524
17	16.9896	0.5933	47	46.9714	1.6403	77	76.9531	2.6873
18	17.9890	0.6282	48	47.9708	1.6752	78	77.9525	2.7222
19	18.9884	0.6631	49	48.9702	1.7101	79	78.9519	2.7571
20	19.9878	0.6980	50	49.9695	1.7450	80	79.9513	2.7920
21	20.9872	0.7329	51	50.9689	1.7799	81	80.9507	2.8269
22	21.9866	0.7678	52	51.9683	1.8148	82	81.9500	2.8618
23	22.9860	0.8027	53	52.9677	1.8497	83	82.9494	2.8967
24	23.9854	0.8376	54	53.9671	1.8846	84	83.9488	2.9316
25	24.9848	0.8725	55	54.9665	1.9195	85	84.9482	2.9665
26	25.9842	0.9074	56	55.9659	1.9544	86	85.9476	3.0014
27	26.9836	0.9423	57	56.9653	1.9893	87	86.9470	3.0363
28	27.9829	0.9772	58	57.9647	2.0242	88	87.9464	3.0712
29	28.9823	1.0121	59	58.9641	2.0591	89	88.9458	3.1061
30	29.9817	1.0470	60	59.9634	2.0940	90	89.9452	3.1410
31	30.9811	1.0819	61	60.9628	2.1289	91	90.9446	3.1759
32	31.9805	1.1168	62	61.9622	2.1638	92	91.9440	3.2108
33	32.9799	1.1517	63	62.9616	2.1987	93	92.9433	3.2457
34	33.9793	1.1866	64	63.9610	2.2336	94	93.9427	3.2806
35	34.9787	1.2215	65	64.9604	2.2685	95	94.9421	3.3155
36	35.9781	1.2564	66	65.9598	2.3034	96	95.9415	3.3504
37	36.9775	1.2913	67	66.9592	2.3383	97	96.9409	3.3853
38	37.9769	1.3262	68	67.9586	2.3732	98	97.9403	3.4202
39	38.9762	1.3611	69	68.9580	2.4081	99	98.9397	3.4551
R	y	x	R	y	x	R	y	x

88°

2°15′

R	x	y	R	x	y	R	x	y
10	9.9923	0.3926	40	39.9692	1.5704	70	69.9460	2.7482
11	10.9915	0.4319	41	40.9684	1.6097	71	70.9453	2.7874
12	11.9907	0.4711	42	41.9676	1.6489	72	71.9445	2.8267
13	12.9900	0.5104	43	42.9668	1.6882	73	72.9437	2.8660
14	13.9892	0.5496	44	43.9661	1.7274	74	73.9429	2.9052
15	14.9884	0.5889	45	44.9653	1.7667	75	74.9422	2.9445
16	15.9877	0.6282	46	45.9645	1.8060	76	75.9414	2.9837
17	16.9869	0.6674	47	46.9638	1.8452	77	76.9406	3.0230
18	17.9861	0.7067	48	47.9630	1.8845	78	77.9399	3.0623
19	18.9854	0.7459	49	48.9622	1.9237	79	78.9391	3.1015
20	19.9846	0.7852	50	49.9614	1.9630	80	79.9383	3.1408
21	20.9838	0.8245	51	50.9607	2.0023	81	80.9376	3.1800
22	21.9830	0.8637	52	51.9599	2.0415	82	81.9367	3.2193
23	22.9823	0.9030	53	52.9591	2.0808	83	82.9360	3.2586
24	23.9815	0.9422	54	53.9583	2.1200	84	83.9353	3.2978
25	24.9807	0.9815	55	54.9576	2.1593	85	84.9345	3.3371
26	25.9800	1.0208	56	55.9568	2.1985	86	85.9337	3.3763
27	26.9792	1.0600	57	56.9561	2.2378	87	86.9329	3.4156
28	27.9784	1.0993	58	57.9553	2.2770	88	87.9322	3.4549
29	28.9776	1.1385	59	58.9545	2.3163	89	88.9314	3.4941
30	29.9769	1.1778	60	59.9537	2.3556	90	89.9306	3.5334
31	30.9761	1.2171	61	60.9530	2.3948	91	90.9298	3.5726
32	31.9753	1.2563	62	61.9522	2.4341	92	91.9291	3.6119
33	32.9746	1.2956	63	62.9514	2.4734	93	92.9283	3.6512
34	33.9738	1.3348	64	63.9507	2.5126	94	93.9275	3.6904
35	34.9730	1.3741	65	64.9499	2.5519	95	94.9268	3.7297
36	35.9722	1.4134	66	65.9491	2.5911	96	95.9260	3.7689
37	36.9715	1.4526	67	66.9483	2.6304	97	96.9252	3.8082
38	37.9707	1.4919	68	67.9476	2.6697	98	97.9244	3.8475
39	38.9699	1.5311	69	68.9468	2.7089	99	98.9237	3.8867
R	y	x	R	y	x	R	y	x

87°45′

2°30′

R	x	y	R	x	y	R	x	y
10	9.9905	0.4362	40	39.9619	1.7448	70	69.9334	3.0534
11	10.9895	0.4798	41	40.9610	1.7884	71	70.9324	3.0970
12	11.9886	0.5234	42	41.9600	1.8320	72	71.9315	3.1406
13	12.9876	0.5671	43	42.9591	1.8756	73	72.9305	3.1842
14	13.9867	0.6107	44	43.9581	1.9193	74	73.9296	3.2278
15	14.9857	0.6543	45	44.9572	1.9629	75	74.9286	3.2715
16	15.9848	0.6979	46	45.9562	2.0065	76	75.9277	3.3151
17	16.9838	0.7415	47	46.9553	2.0501	77	76.9267	3.3587
18	17.9829	0.7851	48	47.9543	2.0937	78	77.9258	3.4023
19	18.9819	0.8288	49	48.9534	2.1374	79	78.9248	3.4459
20	19.9810	0.8724	50	49.9524	2.1810	80	79.9239	3.4896
21	20.9800	0.9160	51	50.9515	2.2246	81	80.9229	3.5332
22	21.9791	0.9596	52	51.9505	2.2682	82	81.9220	3.5768
23	22.9781	1.0032	53	52.9496	2.3118	83	82.9210	3.6204
24	23.9772	1.0469	54	53.9486	2.3554	84	83.9201	3.6640
25	24.9762	1.0905	55	54.9477	2.3991	85	84.9191	3.7076
26	25.9753	1.1341	56	55.9467	2.4427	86	85.9181	3.7513
27	26.9743	1.1777	57	56.9457	2.4863	87	86.9172	3.7949
28	27.9734	1.2213	58	57.9448	2.5299	88	87.9162	3.8385
29	28.9724	1.2650	59	58.9438	2.5735	89	88.9153	3.8821
30	29.9714	1.3086	60	59.9429	2.6172	90	89.9143	3.9257
31	30.9705	1.3522	61	60.9419	2.6608	91	90.9134	3.9694
32	31.9695	1.3958	62	61.9410	2.7044	92	91.9124	4.0130
33	32.9686	1.4394	63	62.9400	2.7480	93	92.9115	4.0566
34	33.9676	1.4831	64	63.9391	2.7916	94	93.9105	4.1002
35	34.9667	1.5267	65	64.9381	2.8353	95	94.9096	4.1438
36	35.9657	1.5703	66	65.9372	2.8789	96	95.9086	4.1875
37	36.9648	1.6139	67	66.9362	2.9225	97	96.9077	4.2311
38	37.9638	1.6575	68	67.9353	2.9661	98	97.9067	4.2747
39	38.9629	1.7012	69	68.9343	3.0097	99	98.9058	4.3183
R	y	x	R	y	x	R	y	x

87°30′

2°45′

R	x	y	R	x	y	R	x	y
10	9.9885	0.4798	40	39.9539	1.9191	70	69.9194	3.3585
11	10.9873	0.5278	41	40.9528	1.9671	71	70.9182	3.4064
12	11.9862	0.5757	42	41.9516	2.0151	72	71.9171	3.4544
13	12.9850	0.6237	43	42.9505	2.0631	73	72.9159	3.5024
14	13.9839	0.6717	44	43.9493	2.1110	74	73.9148	3.5504
15	14.9827	0.7197	45	44.9482	2.1590	75	74.9136	3.5984
16	15.9816	0.7677	46	45.9470	2.2070	76	75.9125	3.6463
17	16.9804	0.8156	47	46.9459	2.2550	77	76.9113	3.6943
18	17.9793	0.8636	48	47.9447	2.3030	78	77.9102	3.7423
19	18.9781	0.9116	49	48.9436	2.3510	79	78.9090	3.7903
20	19.9770	0.9596	50	49.9424	2.3989	80	79.9079	3.8383
21	20.9758	1.0075	51	50.9413	2.4469	81	80.9067	3.8862
22	21.9747	1.0555	52	51.9401	2.4949	82	81.9056	3.9342
23	22.9735	1.1035	53	52.9390	2.5428	83	82.9044	3.9822
24	23.9724	1.1515	54	53.9378	2.5908	84	83.9033	4.0302
25	24.9712	1.1995	55	54.9367	2.6388	85	84.9021	4.0781
26	25.9701	1.2474	56	55.9355	2.6868	86	85.9010	4.1261
27	26.9689	1.2954	57	56.9344	2.7348	87	86.8998	4.1741
28	27.9678	1.3434	58	57.9332	2.7827	88	87.8987	4.2221
29	28.9666	1.3914	59	58.9321	2.8307	89	88.8975	4.2701
30	29.9655	1.4393	60	59.9309	2.8787	90	89.8964	4.3180
31	30.9643	1.4873	61	60.9298	2.9267	91	90.8952	4.3660
32	31.9631	1.5353	62	61.9286	2.9746	92	91.8941	4.4140
33	32.9620	1.5833	63	62.9274	3.0226	93	92.8929	4.4620
34	33.9608	1.6313	64	63.9263	3.0706	94	93.8917	4.5099
35	34.9597	1.6792	65	64.9251	3.1186	95	94.8906	4.5579
36	35.9585	1.7272	66	65.9240	3.1666	96	95.8894	4.6059
37	36.9574	1.7752	67	66.9228	3.2145	97	96.8883	4.6539
38	37.9562	1.8232	68	67.9217	3.2625	98	97.8871	4.7019
39	38.9551	1.8711	69	68.9205	3.3105	99	98.8860	4.7498
R	y	x	R	y	x	R	y	x

87°15′