

湛江市区暴雨强度公式及计算图表

湛江市气象局

湛江市住房和城乡建设局

广东省气象防灾技术服务中心

二零一五年十一月

说

1. 本计算图表以湛江国家气象观测站 35 年(1980~2014 年)连续自记雨量记录为基础,利用国内先进的“降水数字化处理系统”得到高精度的原始数据,采用年最大值法进行编制。

2. 以重现期 2、3、5、10、20、30、50、100 (年)相应的单一重现期暴雨强度公式制表。设计暴雨强度可按选定设计重现期直接查用表列数值(单一重现期暴雨强度公式见表一)。

3. 若采用其它重现期,设计暴雨强度可用重现期区间参数公式计算:

$$q = \frac{167A}{(t+b)^n}$$

式中: q —设计暴雨强度(升/秒·公顷)

t —降雨历时(分钟)

A —雨力

b 、 n —地方常数

(A 、 b 、 n 按重现期区间参数公式计算,公式见表二)

4. 考虑到绘制全国城市暴雨强度公式等值线图,列出包含重现期在内的暴雨强度总公式:

$$q = \frac{4123.986(1+0.607LgP)}{(t+28.766)^{0.693}}$$

因总公式精度不及重现期区间参数公式,故建议推求其它重现期设计暴雨强度时使用区间参数公式。

明

应用重现期区间参数公式计算暴雨强度实例:求 $P=25$ 年, $t=50$ 分钟的暴雨强度 q 。

从重现期区间参数公式 II, 得:

$$n=0.672 - 0.019Ln(P - 7.290)$$

$$=0.61739 \text{ (取 } 0.617)$$

$$b=22.593+1.799Ln(P - 7.842)$$

$$=27.70659 \text{ (取 } 27.707)$$

$$A=29.282+1.350Ln(P - 3.422)$$

$$=33.42876 \text{ (取 } 33.429)$$

配得 $P=25$ 年的暴雨强度计算公式如下:

$$q = \frac{167 \times 33.429}{(t + 27.707)^{0.617}}$$

可按上式计算 1~180 分钟中任何时段的暴雨强度。

当 $t=50$:

$$q = \frac{167 \times 33.429}{(50 + 27.707)^{0.617}} = 380.563 \text{ (升/秒/公顷)}$$

5. 公式误差

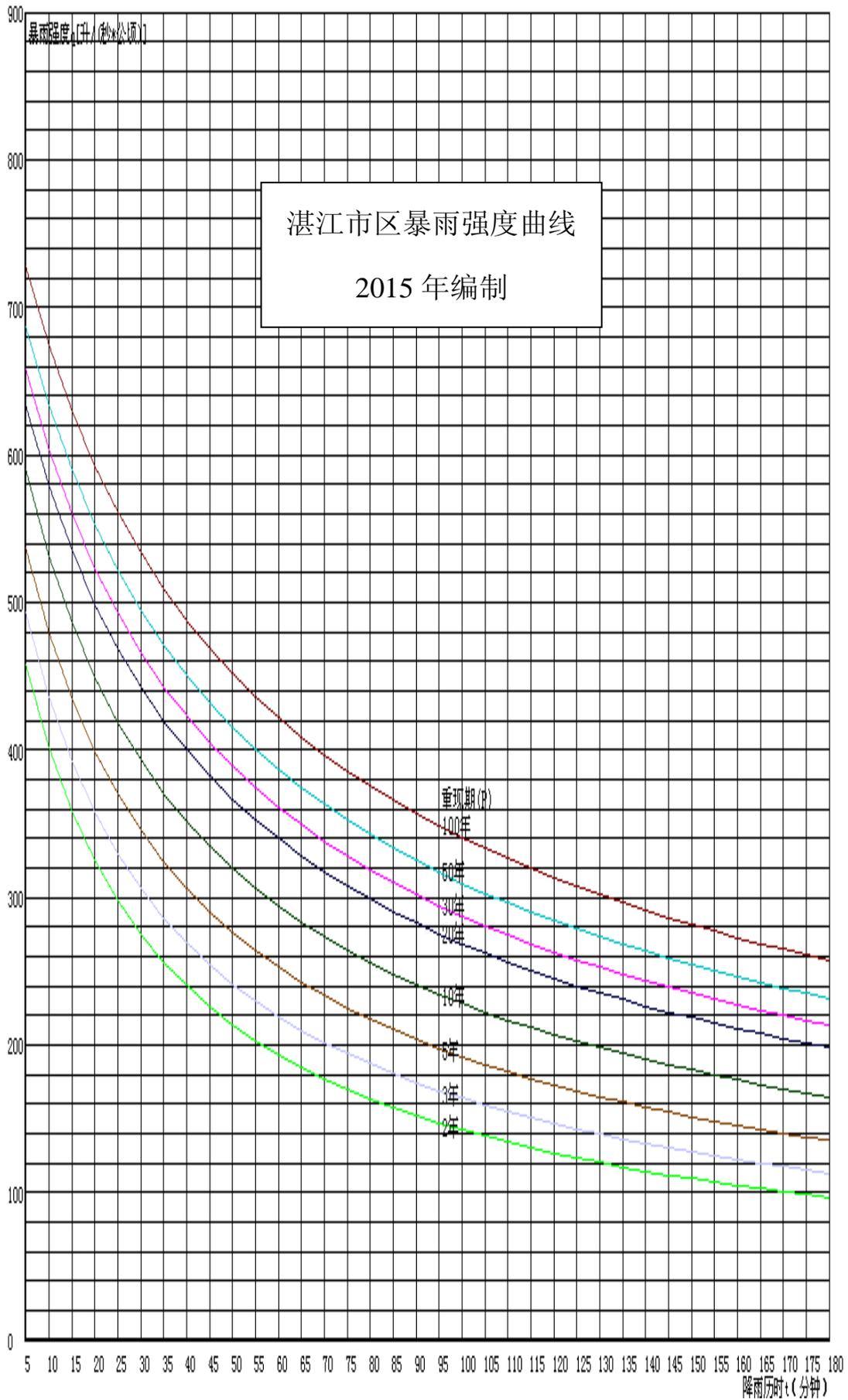
重现期 2~20 年的暴雨强度公式算得的平均绝对均方差为: 0.040 (mm/min), 平均相对均方差为: 1.99%。精度符合《室外排水设计规范》(GB50014—2006, 2014 年版)提出的要求。

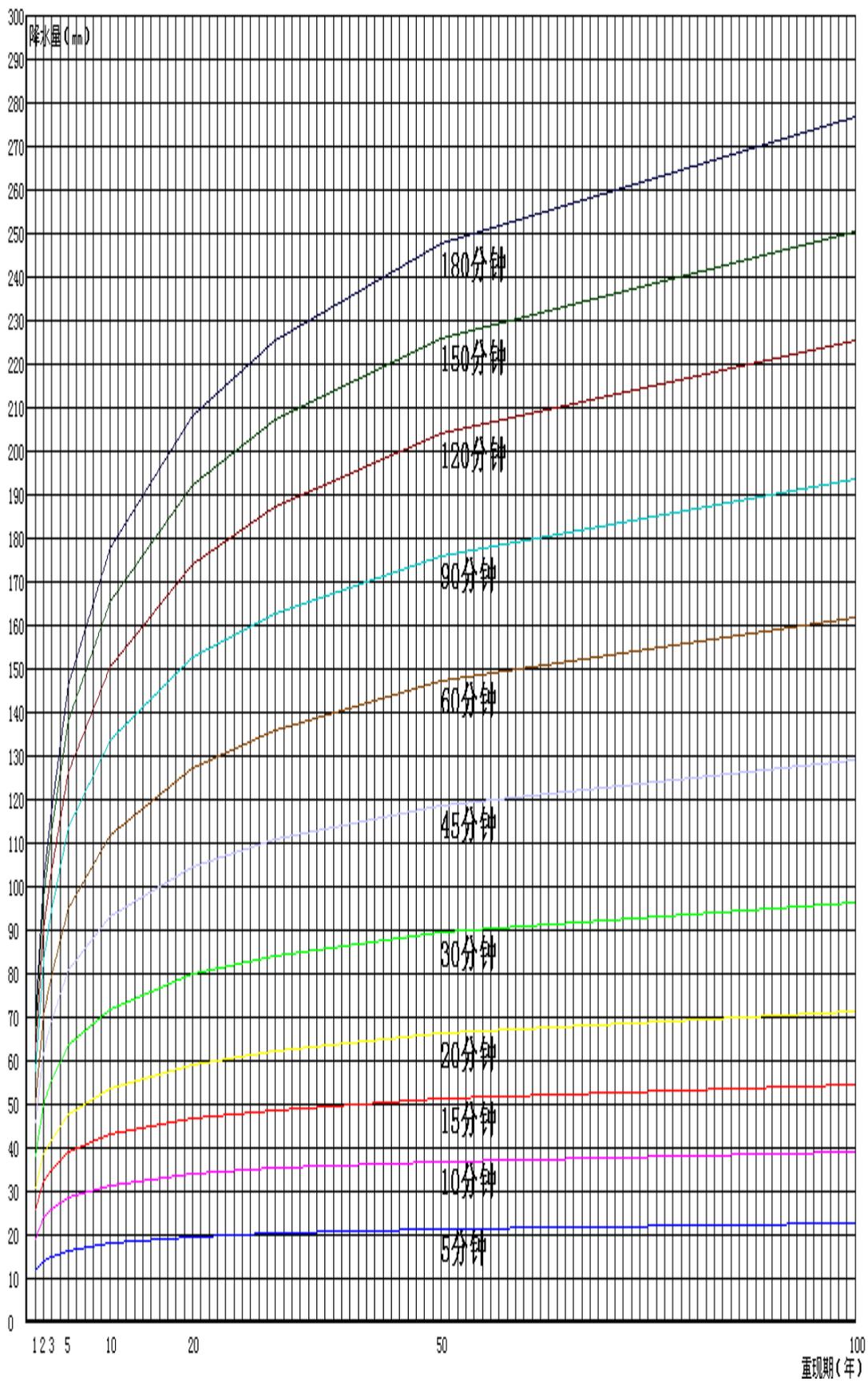
表一 单一重现期暴雨强度公式

重现期 P (年)	公 式
P=2	$5666.811 / (t + 21.574)^{0.767}$
P=3	$5619.383 / (t + 22.421)^{0.735}$
P=5	$5563.438 / (t + 23.316)^{0.699}$
P=10	$5314.775 / (t + 23.977)^{0.653}$
P=20	$5523.191 / (t + 27.087)^{0.624}$
P=30	$5629.570 / (t + 28.167)^{0.613}$
P=40	$5701.547 / (t + 28.837)^{0.606}$
P=50	$5756.156 / (t + 29.324)^{0.601}$
P=60	$5799.91 / (t + 29.707)^{0.597}$
P=70	$5836.65 / (t + 30.022)^{0.593}$
P=80	$5868.213 / (t + 30.291)^{0.591}$
P=90	$5895.768 / (t + 30.524)^{0.588}$
P=100	$5920.484 / (t + 30.731)^{0.586}$

表二 重现期区间暴雨强度公式

P (年)	区间	参数	公 式
1 — 10	I	n	$0.781 - 0.056 \ln(P - 0.706)$
		b	$21.367 + 1.366 \ln(P - 0.836)$
		A	$34.223 - 0.593 \ln(P - 0.369)$
10—100	II	n	$0.672 - 0.019 \ln(P - 7.290)$
		b	$22.593 + 1.799 \ln(P - 7.842)$
		A	$29.282 + 1.350 \ln(P - 3.422)$





延长样本资料后的降水量与重现期曲线图

P=2 (年)

t: 分钟; q: 升/秒·公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	518.945	27	288.315	53	207.522	79	164.980	105	138.306	131	119.842	157	106.217
2	501.975	28	283.843	54	205.413	80	163.733	106	137.474	132	119.243	158	105.763
3	486.232	29	279.529	55	203.352	81	162.507	107	136.653	133	118.651	159	105.314
4	471.582	30	275.362	56	201.338	82	161.303	108	135.843	134	118.066	160	104.868
5	457.910	31	271.336	57	199.370	83	160.118	109	135.044	135	117.487	161	104.428
6	445.118	32	267.443	58	197.445	84	158.954	110	134.256	136	116.914	162	103.991
7	433.121	33	263.676	59	195.563	85	157.808	111	133.479	137	116.349	163	103.559
8	421.843	34	260.029	60	193.722	86	156.682	112	132.712	138	115.789	164	103.130
9	411.219	35	256.497	61	191.920	87	155.574	113	131.955	139	115.235	165	102.706
10	401.193	36	253.073	62	190.156	88	154.484	114	131.208	140	114.688	166	102.286
11	391.712	37	249.752	63	188.429	89	153.411	115	130.470	141	114.146	167	101.870
12	382.732	38	246.530	64	186.738	90	152.355	116	129.742	142	113.611	168	101.457
13	374.212	39	243.403	65	185.081	91	151.316	117	129.024	143	113.081	169	101.049
14	366.117	40	240.365	66	183.458	92	150.293	118	128.314	144	112.557	170	100.644
15	358.414	41	237.413	67	181.867	93	149.286	119	127.613	145	112.038	171	100.243
16	351.075	42	234.543	68	180.308	94	148.294	120	126.921	146	111.525	172	99.845
17	344.073	43	231.753	69	178.779	95	147.318	121	126.238	147	111.017	173	99.451
18	337.385	44	229.037	70	177.280	96	146.356	122	125.563	148	110.515	174	99.061
19	330.988	45	226.394	71	175.809	97	145.408	123	124.896	149	110.017	175	98.674
20	324.865	46	223.819	72	174.366	98	144.475	124	124.238	150	109.525	176	98.291
21	318.996	47	221.312	73	172.950	99	143.555	125	123.587	151	109.038	177	97.911
22	313.366	48	218.868	74	171.561	100	142.648	126	122.944	152	108.556	178	97.535
23	307.959	49	216.485	75	170.197	101	141.755	127	122.309	153	108.079	179	97.161
24	302.763	50	214.162	76	168.857	102	140.874	128	121.681	154	107.606	180	96.792
25	297.764	51	211.894	77	167.542	103	140.006	129	121.061	155	107.139	181	96.425
26	292.952	52	209.682	78	166.250	104	139.150	130	120.448	156	106.676	182	96.061

P=3 (年)

t: 分钟; q: 升/秒·公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	553.387	27	319.642	53	234.278	79	188.445	105	159.344	131	139.016	157	123.906
2	536.639	28	314.970	54	232.021	80	187.091	106	158.431	132	138.353	158	123.401
3	521.041	29	310.456	55	229.815	81	185.760	107	157.531	133	137.698	159	122.900
4	506.473	30	306.092	56	227.657	82	184.450	108	156.642	134	137.051	160	122.405
5	492.830	31	301.870	57	225.547	83	183.163	109	155.765	135	136.410	161	121.914
6	480.025	32	297.783	58	223.482	84	181.896	110	154.900	136	135.777	162	121.428
7	467.978	33	293.824	59	221.461	85	180.650	111	154.045	137	135.151	163	120.946
8	456.621	34	289.988	60	219.483	86	179.424	112	153.202	138	134.531	164	120.469
9	445.894	35	286.267	61	217.546	87	178.217	113	152.370	139	133.918	165	119.996
10	435.744	36	282.657	62	215.649	88	177.030	114	151.548	140	133.311	166	119.528
11	426.122	37	279.153	63	213.791	89	175.860	115	150.737	141	132.711	167	119.064
12	416.988	38	275.750	64	211.970	90	174.709	116	149.936	142	132.117	168	118.604
13	408.302	39	272.443	65	210.185	91	173.576	117	149.145	143	131.530	169	118.148
14	400.032	40	269.228	66	208.435	92	172.459	118	148.363	144	130.949	170	117.696
15	392.147	41	266.101	67	206.719	93	171.360	119	147.591	145	130.373	171	117.249
16	384.619	42	263.059	68	205.036	94	170.277	120	146.829	146	129.804	172	116.805
17	377.423	43	260.098	69	203.385	95	169.210	121	146.076	147	129.240	173	116.366
18	370.538	44	257.214	70	201.766	96	168.158	122	145.332	148	128.682	174	115.930
19	363.941	45	254.404	71	200.176	97	167.122	123	144.596	149	128.130	175	115.498
20	357.616	46	251.666	72	198.616	98	166.101	124	143.870	150	127.584	176	115.070
21	351.544	47	248.996	73	197.084	99	165.095	125	143.152	151	127.042	177	114.646
22	345.709	48	246.393	74	195.579	100	164.102	126	142.442	152	126.507	178	114.225
23	340.099	49	243.852	75	194.102	101	163.124	127	141.741	153	125.976	179	113.808
24	334.698	50	241.373	76	192.650	102	162.159	128	141.048	154	125.451	180	113.394
25	329.496	51	238.952	77	191.224	103	161.208	129	140.363	155	124.931	181	112.984
26	324.481	52	236.588	78	189.822	104	160.270	130	139.685	156	124.416	182	112.578

P=5 (年)

t: 分钟; q: 升/秒·公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	597.867	27	359.626	53	268.779	79	218.974	105	186.920	131	164.302	157	147.359
2	581.260	28	354.713	54	266.344	80	217.490	106	185.908	132	163.562	158	146.790
3	565.730	29	349.959	55	263.962	81	216.031	107	184.910	133	162.830	159	146.227
4	551.173	30	345.358	56	261.632	82	214.595	108	183.924	134	162.106	160	145.669
5	537.493	31	340.901	57	259.350	83	213.182	109	182.952	135	161.390	161	145.116
6	524.611	32	336.582	58	257.117	84	211.792	110	181.991	136	160.681	162	144.568
7	512.454	33	332.393	59	254.929	85	210.423	111	181.043	137	159.980	163	144.025
8	500.960	34	328.328	60	252.787	86	209.076	112	180.107	138	159.286	164	143.487
9	490.073	35	324.383	61	250.687	87	207.749	113	179.182	139	158.599	165	142.954
10	479.743	36	320.550	62	248.630	88	206.443	114	178.269	140	157.920	166	142.426
11	469.928	37	316.826	63	246.613	89	205.156	115	177.367	141	157.247	167	141.902
12	460.586	38	313.205	64	244.635	90	203.889	116	176.476	142	156.582	168	141.384
13	451.684	39	309.684	65	242.695	91	202.641	117	175.596	143	155.923	169	140.869
14	443.189	40	306.257	66	240.793	92	201.411	118	174.727	144	155.271	170	140.360
15	435.071	41	302.920	67	238.926	93	200.199	119	173.868	145	154.626	171	139.854
16	427.306	42	299.671	68	237.094	94	199.004	120	173.019	146	153.987	172	139.353
17	419.870	43	296.505	69	235.296	95	197.827	121	172.180	147	153.354	173	138.857
18	412.740	44	293.419	70	233.531	96	196.667	122	171.351	148	152.728	174	138.365
19	405.898	45	290.410	71	231.797	97	195.523	123	170.531	149	152.108	175	137.876
20	399.325	46	287.475	72	230.095	98	194.395	124	169.721	150	151.494	176	137.393
21	393.004	47	284.611	73	228.422	99	193.282	125	168.921	151	150.886	177	136.913
22	386.922	48	281.816	74	226.779	100	192.186	126	168.129	152	150.284	178	136.437
23	381.063	49	279.086	75	225.164	101	191.104	127	167.346	153	149.687	179	135.965
24	375.416	50	276.420	76	223.577	102	190.036	128	166.573	154	149.097	180	135.498
25	369.968	51	273.815	77	222.017	103	188.983	129	165.807	155	148.512	181	135.034
26	364.708	52	271.268	78	220.483	104	187.945	130	165.051	156	147.932	182	134.574

P=10(年)

t: 分钟; q: 升/秒·公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	649.967	27	407.915	53	311.667	79	257.730	105	222.495	131	197.351	157	178.343
2	633.517	28	402.773	54	309.051	80	256.109	106	221.376	132	196.524	158	177.703
3	618.082	29	397.792	55	306.490	81	254.513	107	220.271	133	195.706	159	177.068
4	603.565	30	392.964	56	303.983	82	252.942	108	219.179	134	194.896	160	176.439
5	589.880	31	388.281	57	301.526	83	251.396	109	218.102	135	194.095	161	175.815
6	576.955	32	383.738	58	299.119	84	249.873	110	217.037	136	193.302	162	175.198
7	564.724	33	379.326	59	296.760	85	248.373	111	215.986	137	192.517	163	174.585
8	553.128	34	375.041	60	294.448	86	246.896	112	214.947	138	191.740	164	173.978
9	542.117	35	370.876	61	292.180	87	245.441	113	213.921	139	190.971	165	173.376
10	531.644	36	366.827	62	289.957	88	244.008	114	212.908	140	190.209	166	172.780
11	521.669	37	362.887	63	287.775	89	242.595	115	211.906	141	189.456	167	172.189
12	512.154	38	359.053	64	285.635	90	241.203	116	210.916	142	188.709	168	171.602
13	503.067	39	355.320	65	283.535	91	239.831	117	209.938	143	187.971	169	171.021
14	494.377	40	351.683	66	281.473	92	238.479	118	208.971	144	187.239	170	170.445
15	486.057	41	348.139	67	279.449	93	237.146	119	208.016	145	186.515	171	169.874
16	478.082	42	344.684	68	277.461	94	235.831	120	207.071	146	185.798	172	169.307
17	470.431	43	341.315	69	275.509	95	234.535	121	206.137	147	185.087	173	168.745
18	463.083	44	338.028	70	273.591	96	233.257	122	205.214	148	184.384	174	168.188
19	456.018	45	334.820	71	271.707	97	231.996	123	204.301	149	183.687	175	167.636
20	449.219	46	331.687	72	269.855	98	230.752	124	203.399	150	182.997	176	167.088
21	442.672	47	328.628	73	268.034	99	229.525	125	202.506	151	182.313	177	166.545
22	436.361	48	325.640	74	266.245	100	228.314	126	201.623	152	181.636	178	166.006
23	430.273	49	322.719	75	264.485	101	227.120	127	200.750	153	180.965	179	165.471
24	424.395	50	319.864	76	262.754	102	225.941	128	199.887	154	180.301	180	164.941
25	418.716	51	317.071	77	261.052	103	224.777	129	199.033	155	179.642	181	164.415
26	413.226	52	314.340	78	259.378	104	223.629	130	198.187	156	178.990	182	163.893

P=20(年)

t: 分钟; q: 升/秒·公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	689.164	27	457.868	53	358.399	79	300.730	105	262.285	131	234.465	157	213.214
2	674.283	28	452.663	54	355.635	80	298.975	106	261.053	132	233.545	158	212.494
3	660.209	29	447.610	55	352.925	81	297.246	107	259.837	133	232.633	159	211.781
4	646.876	30	442.701	56	350.269	82	295.542	108	258.635	134	231.731	160	211.074
5	634.221	31	437.930	57	347.664	83	293.864	109	257.447	135	230.838	161	210.373
6	622.191	32	433.290	58	345.108	84	292.211	110	256.274	136	229.954	162	209.678
7	610.738	33	428.777	59	342.601	85	290.581	111	255.114	137	229.078	163	208.989
8	599.817	34	424.383	60	340.141	86	288.975	112	253.968	138	228.211	164	208.306
9	589.391	35	420.105	61	337.726	87	287.392	113	252.835	139	227.353	165	207.629
10	579.423	36	415.937	62	335.356	88	285.831	114	251.716	140	226.503	166	206.957
11	569.883	37	411.875	63	333.028	89	284.292	115	250.609	141	225.661	167	206.291
12	560.740	38	407.915	64	330.742	90	282.775	116	249.514	142	224.827	168	205.631
13	551.970	39	404.052	65	328.496	91	281.278	117	248.432	143	224.002	169	204.976
14	543.549	40	400.284	66	326.290	92	279.802	118	247.363	144	223.184	170	204.326
15	535.453	41	396.605	67	324.121	93	278.346	119	246.305	145	222.374	171	203.682
16	527.665	42	393.013	68	321.990	94	276.909	120	245.258	146	221.571	172	203.043
17	520.164	43	389.504	69	319.895	95	275.492	121	244.224	147	220.776	173	202.409
18	512.935	44	386.076	70	317.835	96	274.093	122	243.200	148	219.988	174	201.780
19	505.961	45	382.725	71	315.809	97	272.712	123	242.188	149	219.208	175	201.157
20	499.229	46	379.449	72	313.816	98	271.350	124	241.186	150	218.435	176	200.538
21	492.725	47	376.245	73	311.856	99	270.005	125	240.195	151	217.668	177	199.924
22	486.437	48	373.111	74	309.928	100	268.677	126	239.215	152	216.909	178	199.315
23	480.354	49	370.043	75	308.030	101	267.366	127	238.245	153	216.157	179	198.711
24	474.465	50	367.040	76	306.162	102	266.072	128	237.285	154	215.411	180	198.112
25	468.760	51	364.100	77	304.323	103	264.794	129	236.336	155	214.672	181	197.517
26	463.231	52	361.221	78	302.513	104	263.532	130	235.396	156	213.940	182	196.927

P=30(年)

t: 分钟; q: 升/秒·公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	712.027	27	481.754	53	380.212	79	320.662	105	280.686	131	251.617	157	229.329
2	697.464	28	476.478	54	377.369	80	318.842	106	279.401	132	250.652	158	228.573
3	683.660	29	471.352	55	374.581	81	317.048	107	278.132	133	249.698	159	227.824
4	670.552	30	466.368	56	371.846	82	315.281	108	276.878	134	248.753	160	227.081
5	658.086	31	461.520	57	369.164	83	313.539	109	275.639	135	247.817	161	226.344
6	646.211	32	456.803	58	366.531	84	311.823	110	274.415	136	246.891	162	225.614
7	634.884	33	452.210	59	363.948	85	310.131	111	273.204	137	245.973	163	224.889
8	624.065	34	447.737	60	361.412	86	308.463	112	272.008	138	245.065	164	224.171
9	613.718	35	443.379	61	358.922	87	306.818	113	270.825	139	244.165	165	223.459
10	603.810	36	439.130	62	356.477	88	305.196	114	269.656	140	243.274	166	222.753
11	594.313	37	434.987	63	354.075	89	303.597	115	268.500	141	242.392	167	222.053
12	585.199	38	430.945	64	351.715	90	302.020	116	267.356	142	241.518	168	221.358
13	576.443	39	427.001	65	349.396	91	300.463	117	266.226	143	240.652	169	220.669
14	568.024	40	423.150	66	347.117	92	298.928	118	265.108	144	239.794	170	219.986
15	559.921	41	419.389	67	344.876	93	297.413	119	264.002	145	238.944	171	219.308
16	552.116	42	415.715	68	342.673	94	295.919	120	262.908	146	238.102	172	218.636
17	544.590	43	412.124	69	340.507	95	294.444	121	261.827	147	237.268	173	217.969
18	537.329	44	408.614	70	338.377	96	292.988	122	260.756	148	236.441	174	217.308
19	530.316	45	405.182	71	336.281	97	291.551	123	259.698	149	235.622	175	216.651
20	523.540	46	401.824	72	334.219	98	290.132	124	258.650	150	234.811	176	216.000
21	516.987	47	398.539	73	332.190	99	288.731	125	257.614	151	234.007	177	215.354
22	510.645	48	395.323	74	330.193	100	287.348	126	256.588	152	233.210	178	214.713
23	504.504	49	392.175	75	328.227	101	285.982	127	255.573	153	232.420	179	214.077
24	498.553	50	389.092	76	326.292	102	284.634	128	254.569	154	231.637	180	213.446
25	492.784	51	386.071	77	324.387	103	283.301	129	253.575	155	230.861	181	212.820
26	487.187	52	383.112	78	322.510	104	281.986	130	252.591	156	230.091	182	212.199

P=40 (年)

t: 分钟; q: 升/秒·公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	728.935	27	498.686	53	395.602	79	334.719	105	293.668	131	263.727	157	240.716
2	714.524	28	493.353	54	392.702	80	332.852	106	292.347	132	262.732	158	239.935
3	700.844	29	488.168	55	389.858	81	331.013	107	291.041	133	261.748	159	239.161
4	687.836	30	483.125	56	387.068	82	329.201	108	289.751	134	260.773	160	238.393
5	675.450	31	478.218	57	384.330	83	327.415	109	288.476	135	259.807	161	237.631
6	663.638	32	473.441	58	381.643	84	325.654	110	287.216	136	258.852	162	236.876
7	652.359	33	468.788	59	379.005	85	323.918	111	285.970	137	257.905	163	236.127
8	641.573	34	464.255	60	376.415	86	322.207	112	284.738	138	256.967	164	235.385
9	631.248	35	459.836	61	373.872	87	320.519	113	283.520	139	256.039	165	234.649
10	621.352	36	455.527	62	371.373	88	318.855	114	282.316	140	255.119	166	233.918
11	611.857	37	451.323	63	368.918	89	317.213	115	281.126	141	254.208	167	233.194
12	602.737	38	447.221	64	366.506	90	315.593	116	279.948	142	253.306	168	232.476
13	593.968	39	443.216	65	364.135	91	313.995	117	278.784	143	252.412	169	231.763
14	585.530	40	439.305	66	361.804	92	312.419	118	277.633	144	251.526	170	231.057
15	577.403	41	435.483	67	359.513	93	310.863	119	276.493	145	250.649	171	230.355
16	569.567	42	431.749	68	357.260	94	309.328	120	275.367	146	249.780	172	229.660
17	562.008	43	428.098	69	355.043	95	307.812	121	274.252	147	248.918	173	228.970
18	554.708	44	424.529	70	352.863	96	306.316	122	273.149	148	248.065	174	228.286
19	547.655	45	421.036	71	350.718	97	304.839	123	272.058	149	247.219	175	227.607
20	540.835	46	417.620	72	348.607	98	303.381	124	270.978	150	246.380	176	226.933
21	534.235	47	414.275	73	346.529	99	301.942	125	269.910	151	245.550	177	226.264
22	527.845	48	411.001	74	344.484	100	300.520	126	268.853	152	244.726	178	225.601
23	521.653	49	407.794	75	342.471	101	299.116	127	267.807	153	243.910	179	224.943
24	515.650	50	404.653	76	340.488	102	297.729	128	266.771	154	243.101	180	224.290
25	509.827	51	401.575	77	338.536	103	296.359	129	265.746	155	242.299	181	223.642
26	504.175	52	398.559	78	336.613	104	295.005	130	264.731	156	241.504	182	222.999

P=50 (年)

t: 分钟; q: 升/秒·公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	740.592	27	510.465	53	406.351	79	344.559	105	302.770	131	272.225	157	248.714
2	726.290	28	505.094	54	403.413	80	342.661	106	301.423	132	271.210	158	247.916
3	712.702	29	499.871	55	400.531	81	340.791	107	300.092	133	270.204	159	247.124
4	699.770	30	494.790	56	397.703	82	338.948	108	298.777	134	269.209	160	246.338
5	687.445	31	489.844	57	394.928	83	337.131	109	297.477	135	268.223	161	245.560
6	675.682	32	485.028	58	392.203	84	335.340	110	296.192	136	267.247	162	244.787
7	664.441	33	480.336	59	389.529	85	333.574	111	294.921	137	266.280	163	244.022
8	653.684	34	475.762	60	386.902	86	331.832	112	293.665	138	265.322	164	243.262
9	643.379	35	471.303	61	384.322	87	330.115	113	292.424	139	264.374	165	242.509
10	633.495	36	466.954	62	381.787	88	328.421	114	291.196	140	263.435	166	241.762
11	624.006	37	462.710	63	379.296	89	326.750	115	289.981	141	262.504	167	241.021
12	614.886	38	458.567	64	376.848	90	325.102	116	288.780	142	261.582	168	240.287
13	606.113	39	454.521	65	374.442	91	323.475	117	287.593	143	260.669	169	239.558
14	597.666	40	450.569	66	372.076	92	321.870	118	286.418	144	259.764	170	238.835
15	589.525	41	446.708	67	369.750	93	320.286	119	285.256	145	258.867	171	238.117
16	581.674	42	442.933	68	367.462	94	318.723	120	284.106	146	257.979	172	237.406
17	574.094	43	439.242	69	365.211	95	317.179	121	282.969	147	257.098	173	236.700
18	566.772	44	435.632	70	362.997	96	315.656	122	281.843	148	256.226	174	236.000
19	559.694	45	432.100	71	360.818	97	314.152	123	280.730	149	255.362	175	235.305
20	552.846	46	428.643	72	358.674	98	312.667	124	279.628	150	254.505	176	234.615
21	546.218	47	425.259	73	356.563	99	311.200	125	278.538	151	253.656	177	233.931
22	539.796	48	421.945	74	354.485	100	309.751	126	277.459	152	252.814	178	233.252
23	533.572	49	418.699	75	352.439	101	308.321	127	276.391	153	251.980	179	232.579
24	527.536	50	415.519	76	350.424	102	306.908	128	275.333	154	251.153	180	231.910
25	521.678	51	412.402	77	348.439	103	305.512	129	274.287	155	250.333	181	231.247
26	515.990	52	409.347	78	346.484	104	304.132	130	273.251	156	249.520	182	230.589

P=60 (年)

t: 分钟; q: 升/秒·公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	751.686	27	521.295	53	416.184	79	353.551	105	311.087	131	279.995	157	256.031
2	737.449	28	515.886	54	413.211	80	351.624	106	309.718	132	278.961	158	255.216
3	723.912	29	510.624	55	410.293	81	349.726	107	308.364	133	277.937	159	254.408
4	711.020	30	505.504	56	407.430	82	347.854	108	307.026	134	276.922	160	253.607
5	698.724	31	500.519	57	404.620	83	346.010	109	305.703	135	275.918	161	252.813
6	686.981	32	495.663	58	401.861	84	344.191	110	304.396	136	274.923	162	252.025
7	675.752	33	490.932	59	399.151	85	342.397	111	303.103	137	273.938	163	251.244
8	665.001	34	486.319	60	396.490	86	340.628	112	301.825	138	272.962	164	250.469
9	654.696	35	481.821	61	393.877	87	338.884	113	300.561	139	271.996	165	249.701
10	644.807	36	477.432	62	391.308	88	337.163	114	299.311	140	271.038	166	248.939
11	635.309	37	473.148	63	388.784	89	335.465	115	298.076	141	270.090	167	248.183
12	626.175	38	468.966	64	386.303	90	333.791	116	296.853	142	269.150	168	247.433
13	617.385	39	464.882	65	383.864	91	332.138	117	295.644	143	268.219	169	246.690
14	608.917	40	460.891	66	381.466	92	330.507	118	294.448	144	267.297	170	245.952
15	600.754	41	456.990	67	379.108	93	328.897	119	293.265	145	266.383	171	245.220
16	592.876	42	453.177	68	376.788	94	327.308	120	292.095	146	265.477	172	244.494
17	585.269	43	449.448	69	374.505	95	325.739	121	290.937	147	264.580	173	243.773
18	577.918	44	445.799	70	372.260	96	324.191	122	289.791	148	263.690	174	243.059
19	570.809	45	442.229	71	370.050	97	322.662	123	288.657	149	262.809	175	242.349
20	563.929	46	438.734	72	367.874	98	321.152	124	287.535	150	261.935	176	241.646
21	557.267	47	435.313	73	365.733	99	319.661	125	286.425	151	261.070	177	240.948
22	550.811	48	431.961	74	363.625	100	318.188	126	285.326	152	260.211	178	240.255
23	544.551	49	428.678	75	361.549	101	316.733	127	284.238	153	259.361	179	239.567
24	538.478	50	425.461	76	359.504	102	315.296	128	283.161	154	258.517	180	238.885
25	532.584	51	422.308	77	357.490	103	313.876	129	282.095	155	257.681	181	238.208
26	526.858	52	419.216	78	355.506	104	312.474	130	281.040	156	256.853	182	237.536

P=70 (年)

t: 分钟; q: 升/秒·公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	760.413	27	529.883	53	424.006	79	360.715	105	317.721	131	286.197	157	261.874
2	746.232	28	524.445	54	421.005	80	358.766	106	316.333	132	285.148	158	261.047
3	732.739	29	519.155	55	418.059	81	356.845	107	314.962	133	284.109	159	260.226
4	719.882	30	514.005	56	415.169	82	354.952	108	313.605	134	283.080	160	259.413
5	707.614	31	508.990	57	412.331	83	353.085	109	312.265	135	282.060	161	258.606
6	695.891	32	504.104	58	409.545	84	351.244	110	310.940	136	281.051	162	257.806
7	684.676	33	499.343	59	406.809	85	349.429	111	309.630	137	280.051	163	257.013
8	673.933	34	494.700	60	404.122	86	347.639	112	308.334	138	279.061	164	256.226
9	663.631	35	490.171	61	401.481	87	345.873	113	307.053	139	278.080	165	255.446
10	653.742	36	485.752	62	398.887	88	344.131	114	305.786	140	277.109	166	254.671
11	644.238	37	481.439	63	396.337	89	342.412	115	304.533	141	276.146	167	253.904
12	635.097	38	477.226	64	393.830	90	340.717	116	303.294	142	275.192	168	253.142
13	626.296	39	473.112	65	391.366	91	339.043	117	302.068	143	274.248	169	252.387
14	617.815	40	469.091	66	388.942	92	337.392	118	300.856	144	273.311	170	251.637
15	609.635	41	465.160	67	386.558	93	335.762	119	299.656	145	272.384	171	250.894
16	601.740	42	461.317	68	384.213	94	334.153	120	298.469	146	271.464	172	250.156
17	594.114	43	457.558	69	381.906	95	332.564	121	297.295	147	270.553	173	249.424
18	586.741	44	453.880	70	379.636	96	330.996	122	296.133	148	269.651	174	248.698
19	579.610	45	450.280	71	377.402	97	329.447	123	294.983	149	268.756	175	247.977
20	572.706	46	446.756	72	375.202	98	327.918	124	293.845	150	267.869	176	247.263
21	566.019	47	443.306	73	373.037	99	326.407	125	292.719	151	266.990	177	246.553
22	559.537	48	439.925	74	370.905	100	324.916	126	291.605	152	266.119	178	245.849
23	553.251	49	436.613	75	368.805	101	323.442	127	290.501	153	265.255	179	245.151
24	547.152	50	433.368	76	366.737	102	321.986	128	289.409	154	264.399	180	244.457
25	541.229	51	430.186	77	364.700	103	320.547	129	288.328	155	263.550	181	243.769
26	535.476	52	427.066	78	362.693	104	319.126	130	287.257	156	262.708	182	243.086

P=80 (年)

t: 分钟; q: 升/秒·公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	768.024	27	537.346	53	430.805	79	366.947	105	323.495	131	291.597	157	266.964
2	753.888	28	531.883	54	427.780	80	364.978	106	322.091	132	290.535	158	266.126
3	740.431	29	526.566	55	424.810	81	363.038	107	320.704	133	289.483	159	265.294
4	727.602	30	521.391	56	421.896	82	361.125	108	319.332	134	288.441	160	264.470
5	715.354	31	516.350	57	419.035	83	359.239	109	317.976	135	287.409	161	263.653
6	703.647	32	511.439	58	416.226	84	357.380	110	316.636	136	286.387	162	262.842
7	692.441	33	506.651	59	413.467	85	355.546	111	315.310	137	285.375	163	262.038
8	681.704	34	501.982	60	410.756	86	353.737	112	314.000	138	284.372	164	261.241
9	671.404	35	497.427	61	408.093	87	351.953	113	312.704	139	283.379	165	260.450
10	661.512	36	492.982	62	405.476	88	350.193	114	311.422	140	282.395	166	259.666
11	652.003	37	488.642	63	402.903	89	348.456	115	310.154	141	281.420	167	258.888
12	642.854	38	484.404	64	400.374	90	346.742	116	308.901	142	280.455	168	258.116
13	634.043	39	480.263	65	397.888	91	345.051	117	307.660	143	279.498	169	257.350
14	625.549	40	476.216	66	395.442	92	343.382	118	306.433	144	278.550	170	256.591
15	617.355	41	472.260	67	393.037	93	341.735	119	305.220	145	277.610	171	255.837
16	609.444	42	468.391	68	390.670	94	340.108	120	304.019	146	276.679	172	255.089
17	601.800	43	464.606	69	388.342	95	338.503	121	302.830	147	275.756	173	254.348
18	594.409	44	460.903	70	386.051	96	336.917	122	301.654	148	274.842	174	253.612
19	587.257	45	457.278	71	383.795	97	335.352	123	300.491	149	273.936	175	252.881
20	580.333	46	453.728	72	381.575	98	333.805	124	299.339	150	273.037	176	252.157
21	573.624	47	450.252	73	379.389	99	332.278	125	298.199	151	272.147	177	251.438
22	567.120	48	446.847	74	377.236	100	330.770	126	297.071	152	271.264	178	250.724
23	560.811	49	443.510	75	375.116	101	329.280	127	295.954	153	270.389	179	250.016
24	554.688	50	440.240	76	373.028	102	327.807	128	294.848	154	269.522	180	249.313
25	548.741	51	437.033	77	370.971	103	326.353	129	293.754	155	268.662	181	248.616
26	542.963	52	433.889	78	368.944	104	324.915	130	292.670	156	267.809	182	247.923

P=90 (年)

t: 分钟; q: 升/秒·公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	774.784	27	543.954	53	436.829	79	372.471	105	328.616	131	296.389	157	271.482
2	760.684	28	538.469	54	433.782	80	370.485	106	327.198	132	295.315	158	270.634
3	747.256	29	533.130	55	430.792	81	368.528	107	325.797	133	294.252	159	269.794
4	734.450	30	527.932	56	427.857	82	366.598	108	324.411	134	293.199	160	268.960
5	722.220	31	522.868	57	424.975	83	364.696	109	323.042	135	292.156	161	268.133
6	710.524	32	517.934	58	422.145	84	362.819	110	321.688	136	291.122	162	267.313
7	699.326	33	513.123	59	419.366	85	360.969	111	320.349	137	290.099	163	266.500
8	688.593	34	508.431	60	416.635	86	359.144	112	319.025	138	289.086	164	265.693
9	678.292	35	503.854	61	413.952	87	357.344	113	317.716	139	288.081	165	264.893
10	668.398	36	499.385	62	411.315	88	355.567	114	316.422	140	287.087	166	264.100
11	658.884	37	495.022	63	408.722	89	353.815	115	315.141	141	286.101	167	263.313
12	649.727	38	490.761	64	406.174	90	352.085	116	313.874	142	285.125	168	262.532
13	640.906	39	486.597	65	403.668	91	350.379	117	312.621	143	284.157	169	261.757
14	632.401	40	482.528	66	401.203	92	348.694	118	311.382	144	283.199	170	260.989
15	624.194	41	478.549	67	398.778	93	347.031	119	310.155	145	282.249	171	260.226
16	616.268	42	474.657	68	396.393	94	345.389	120	308.942	146	281.307	172	259.470
17	608.608	43	470.849	69	394.046	95	343.768	121	307.741	147	280.374	173	258.719
18	601.200	44	467.123	70	391.736	96	342.168	122	306.553	148	279.449	174	257.975
19	594.031	45	463.476	71	389.462	97	340.587	123	305.377	149	278.533	175	257.236
20	587.088	46	459.904	72	387.223	98	339.026	124	304.213	150	277.624	176	256.502
21	580.360	47	456.406	73	385.019	99	337.485	125	303.061	151	276.724	177	255.775
22	573.836	48	452.979	74	382.848	100	335.962	126	301.921	152	275.831	178	255.053
23	567.506	49	449.620	75	380.711	101	334.457	127	300.792	153	274.946	179	254.336
24	561.362	50	446.328	76	378.605	102	332.970	128	299.675	154	274.069	180	253.625
25	555.393	51	443.100	77	376.530	103	331.502	129	298.569	155	273.199	181	252.919
26	549.594	52	439.934	78	374.486	104	330.050	130	297.474	156	272.337	182	252.218

P=100(年)

t: 分钟; q: 升/秒·公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	780.706	27	549.758	53	442.126	79	377.333	105	333.125	131	300.611	157	275.464
2	766.639	28	544.253	54	439.061	80	375.332	106	331.695	132	299.527	158	274.608
3	753.238	29	538.895	55	436.052	81	373.360	107	330.282	133	298.453	159	273.759
4	740.452	30	533.677	56	433.099	82	371.415	108	328.885	134	297.390	160	272.917
5	728.237	31	528.594	57	430.199	83	369.498	109	327.503	135	296.338	161	272.082
6	716.553	32	523.640	58	427.351	84	367.607	110	326.138	136	295.295	162	271.254
7	705.362	33	518.809	59	424.554	85	365.743	111	324.787	137	294.262	163	270.432
8	694.632	34	514.097	60	421.806	86	363.903	112	323.452	138	293.239	164	269.618
9	684.333	35	509.500	61	419.105	87	362.089	113	322.131	139	292.225	165	268.810
10	674.437	36	505.011	62	416.451	88	360.299	114	320.825	140	291.221	166	268.008
11	664.918	37	500.629	63	413.841	89	358.532	115	319.533	141	290.226	167	267.213
12	655.755	38	496.347	64	411.275	90	356.789	116	318.255	142	289.240	168	266.424
13	646.926	39	492.164	65	408.752	91	355.068	117	316.991	143	288.263	169	265.642
14	638.411	40	488.074	66	406.271	92	353.370	118	315.740	144	287.295	170	264.865
15	630.193	41	484.075	67	403.830	93	351.694	119	314.503	145	286.336	171	264.095
16	622.255	42	480.164	68	401.428	94	350.039	120	313.278	146	285.386	172	263.331
17	614.582	43	476.337	69	399.064	95	348.405	121	312.067	147	284.443	173	262.573
18	607.160	44	472.591	70	396.738	96	346.791	122	310.868	148	283.510	174	261.820
19	599.976	45	468.924	71	394.448	97	345.197	123	309.681	149	282.584	175	261.074
20	593.017	46	465.333	72	392.193	98	343.624	124	308.507	150	281.667	176	260.333
21	586.272	47	461.816	73	389.973	99	342.069	125	307.344	151	280.758	177	259.598
22	579.731	48	458.370	74	387.787	100	340.533	126	306.194	152	279.856	178	258.869
23	573.384	49	454.992	75	385.633	101	339.016	127	305.055	153	278.963	179	258.145
24	567.221	50	451.681	76	383.512	102	337.517	128	303.927	154	278.077	180	257.426
25	561.235	51	448.434	77	381.422	103	336.036	129	302.811	155	277.199	181	256.713
26	555.416	52	445.250	78	379.362	104	334.572	130	301.705	156	276.328	182	256.005

