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市污水处理有限责任公司
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市污水处理有限责任公司
转发件

广州市水务局文件

穗水〔2011〕214号

印发《广州市中心城区暴雨公式 及计算图表》的通知

市建委、发改委、规划局、林业园林局、城管委、水投集团，各区（县级市）水务（建设和水务、水务和农业、农业水利、农林水利）局、萝岗区建设和环境管理局、从化市城乡建设局、局属有关单位：

在全球气候变化的背景下，广州地区暴雨特征发生了显著变化，为此，我局委托了广东省气象中心对广州中心城区最近的60年、30年和20年降雨系列资料进行分析研究，提出了相应的暴雨公式及计算图表，并与1993年颁布使用的暴雨公式及计算图表进行对比分析研究，结果表明，最近20年系列暴雨特性及相应的暴雨强度公式及计算图表成果更符合广州的实际情况，该

成果已通过专家审查。1993 年的印发的广州市暴雨公式及计算图表废止使用。现将新编制的《广州市中心城区暴雨公式及计算图表》(2011 年 6 月版)印发给你们,请认真执行。执行过程中遇到的问题,请及时向我局反映。

特此通知。

附件:广州市中心城区暴雨公式及计算图表



二〇一一年十二月二十九日

主题词: 城乡建设 暴雨公式△ 通知

广州市水务局办公室

2011 年 12 月 31 日印发

说

1. 本计算图表根据广州国家基本气象站近 20 年(1990~2010 年 6 月)连续自记雨量记录编制。

2. 以重现期 0.25、0.33、0.5、1、2、3、5、10、20、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 —常数

(A 、 b 、 n 按重现期区间参数公式计算,公式见表二)

4. 暴雨强度总公式:

$$q = \frac{3618.427(1+0.438LgP)}{(t+11.259)^{0.750}}$$

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

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 III, 得:

明

$$n=0.775 - 0.047 \text{Ln}(P-6.565)$$

$$= 0.63803 \text{ (取 } 0.638)$$

$$b=12.547 - 1.681 \text{Ln}(P-8.255)$$

$$= 7.80977 \text{ (取 } 7.81)$$

$$A=30.960 - 2.489 \text{Ln}(P-8.666)$$

$$= 24.00760 \text{ (取 } 24.008)$$

配得 $P=25$ 年的暴雨强度计算公式如下:

$$q = \frac{4009.336}{(t+7.81)^{0.638}}$$

可按上式计算 1~200 分钟中任何时段的暴雨强度。

当 $t=50$ 分钟:

$$q = \frac{4009.336}{(t+7.81)^{0.638}} = 301.241 \text{ (升/秒/公顷)}$$

5. 公式误差

应用暴雨强度区间公式算得的重现期 0.25~10 年暴雨强度平均绝对方差为: 0.047(mm/min), 平均相对方差为: 2.91%。精度符合国家《室外排水设计规范》(GB50014-2006) 提出的要求。

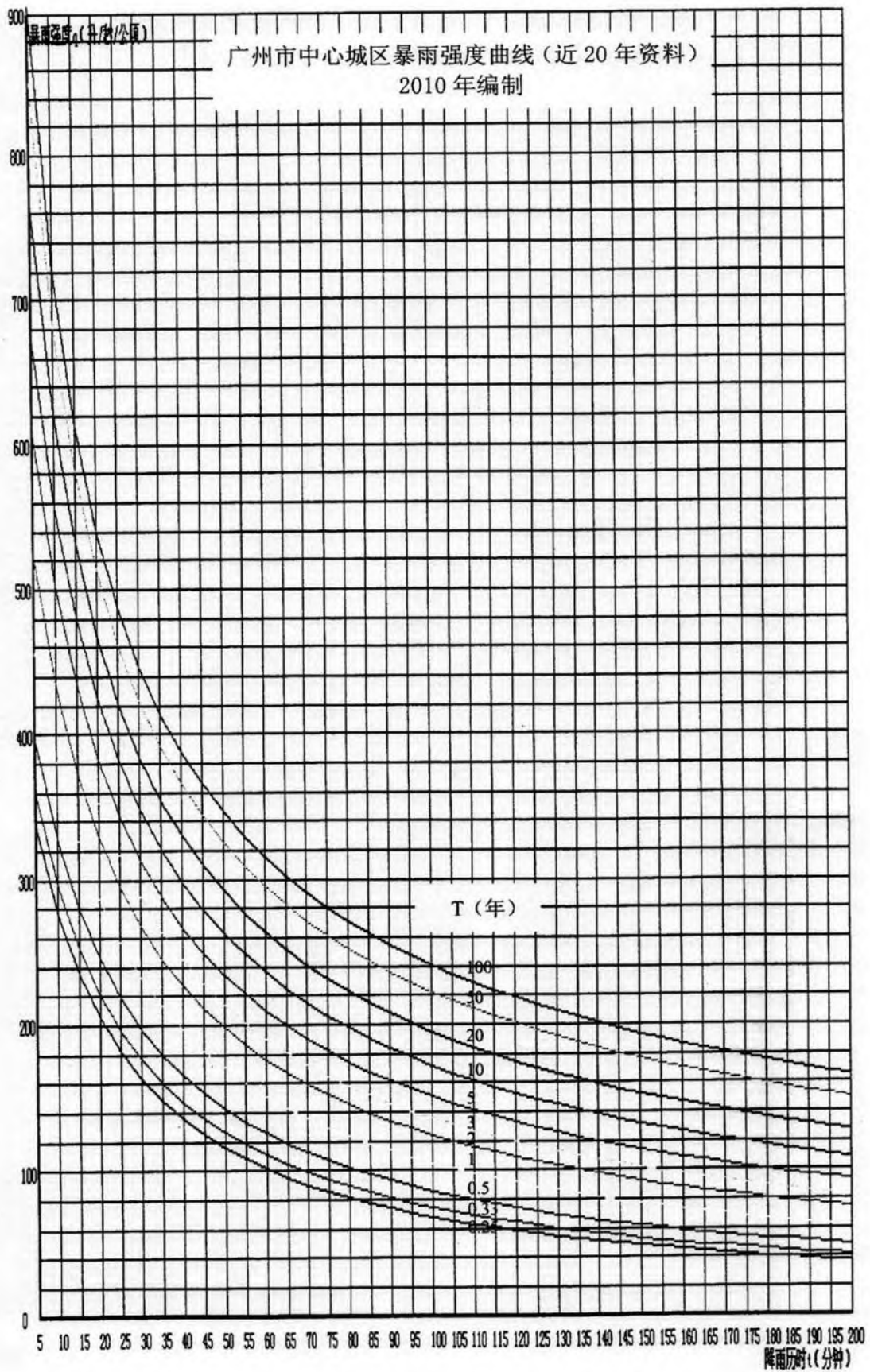
应用暴雨强度总公式算得的重现期 0.25~10 年暴雨强度平均绝对方差为: 0.069 (mm/min), 平均相对方差为: 4.91%, 符合国家《室外排水设计规范》(GB50014-2006) 提出的在强度较大的地方平均相对方差不超过 5% 提出的精度要求。

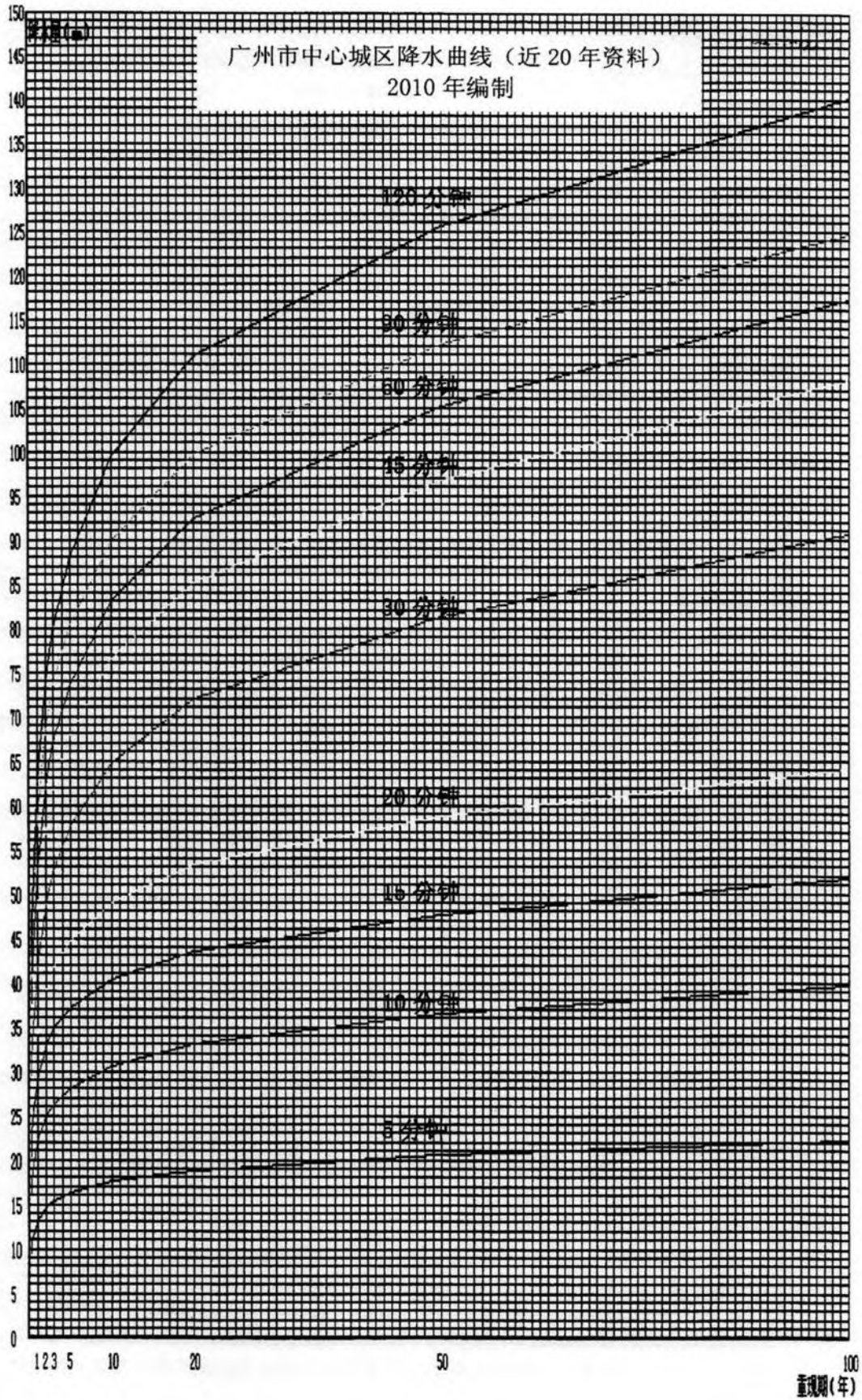
表一 单一重现期暴雨强度公式

重现期 P (年)	公 式
P=0.25	$6976.425/(t+17.660)^{0.972}$
P=0.33	$6737.448/(t+17.269)^{0.945}$
P=0.5	$6561.430/(t+16.812)^{0.911}$
P=1	$6366.875/(t+16.190)^{0.863}$
P=2	$5920.317/(t+14.646)^{0.815}$
P=3	$5688.521/(t+13.841)^{0.789}$
P=5	$5411.802/(t+12.874)^{0.758}$
P=10	$5050.414/(t+11.610)^{0.717}$
P=20	$4161.139/(t+8.406)^{0.653}$
P=50	$3623.399/(t+6.274)^{0.598}$
P=100	$3293.741/(t+4.951)^{0.562}$

表二 重现期区间暴雨强度公式

重现期 P (年)	区间	参数	公 式
0.25—1	I	n	$0.856 - 0.570 \text{ Ln}(P-0.120)$
		b	$16.082 - 0.715 \text{ Ln}(P-0.140)$
		A	$37.844 - 1.142 \text{ Ln}(P-0.218)$
1—10	II	n	$0.847 - 0.057 \text{ Ln}(P-0.245)$
		b	$15.578 - 1.746 \text{ Ln}(P-0.295)$
		A	$37.009 - 2.980 \text{ Ln}(P-0.313)$
10—100	III	n	$0.775 - 0.047 \text{ Ln}(P-6.565)$
		b	$12.547 - 1.681 \text{ Ln}(P-8.255)$
		A	$30.960 - 2.489 \text{ Ln}(P-8.666)$





P=0.25(年)

t: 分钟; q: 升/秒/公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	405.795	26	177.612	51	114.382	76	84.583	101	67.206	126	55.809	151	47.750	176	41.747
2	385.718	27	173.745	52	112.785	77	83.714	102	66.660	127	55.434	152	47.477	177	41.539
3	367.558	28	170.045	53	111.234	78	82.863	103	66.123	128	55.064	153	47.206	178	41.333
4	351.053	29	166.502	54	109.725	79	82.030	104	65.595	129	54.699	154	46.939	179	41.128
5	335.985	30	163.105	55	108.256	80	81.214	105	65.075	130	54.339	155	46.675	180	40.926
6	322.174	31	159.846	56	106.828	81	80.413	106	64.563	131	53.983	156	46.414	181	40.726
7	309.468	32	156.716	57	105.437	82	79.629	107	64.060	132	53.633	157	46.155	182	40.528
8	297.739	33	153.709	58	104.082	83	78.860	108	63.564	133	53.287	158	45.900	183	40.331
9	286.878	34	150.816	59	102.762	84	78.106	109	63.076	134	52.945	159	45.647	184	40.137
10	276.791	35	148.031	60	101.475	85	77.366	110	62.596	135	52.608	160	45.397	185	39.944
11	267.399	36	145.349	61	100.221	86	76.641	111	62.123	136	52.275	161	45.150	186	39.754
12	258.632	37	142.764	62	98.998	87	75.929	112	61.657	137	51.947	162	44.906	187	39.565
13	250.429	38	140.270	63	97.805	88	75.230	113	61.199	138	51.622	163	44.665	188	39.378
14	242.737	39	137.863	64	96.641	89	74.544	114	60.747	139	51.302	164	44.426	189	39.193
15	235.510	40	135.539	65	95.504	90	73.871	115	60.302	140	50.986	165	44.189	190	39.009
16	228.706	41	133.292	66	94.394	91	73.210	116	59.863	141	50.673	166	43.955	191	38.827
17	222.290	42	131.120	67	93.310	92	72.561	117	59.431	142	50.365	167	43.724	192	38.647
18	216.228	43	129.018	68	92.251	93	71.924	118	59.005	143	50.060	168	43.495	193	38.469
19	210.493	44	126.984	69	91.216	94	71.298	119	58.585	144	49.759	169	43.268	194	38.292
20	205.058	45	125.014	70	90.205	95	70.683	120	58.172	145	49.462	170	43.044	195	38.117
21	199.901	46	123.105	71	89.216	96	70.078	121	57.764	146	49.168	171	42.823	196	37.944
22	195.000	47	121.254	72	88.248	97	69.484	122	57.362	147	48.878	172	42.603	197	37.772
23	190.337	48	119.458	73	87.302	98	68.900	123	56.965	148	48.591	173	42.386	198	37.602
24	185.894	49	117.716	74	86.376	99	68.326	124	56.574	149	48.307	174	42.171	199	37.433
25	181.657	50	116.025	75	85.470	100	67.761	125	56.189	150	48.027	175	41.958	200	37.266

P=0.33(年)

t: 分钟; q: 升/秒/公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	432.688	26	191.562	51	124.496	76	92.703	101	74.068	126	61.792	151	53.079	176	46.566
2	411.437	27	187.470	52	122.797	77	91.773	102	73.481	127	61.387	152	52.782	177	46.340
3	392.228	28	183.554	53	121.144	78	90.863	103	72.904	128	60.988	153	52.489	178	46.116
4	374.778	29	179.803	54	119.538	79	89.971	104	72.336	129	60.594	154	52.200	179	45.893
5	358.854	30	176.206	55	117.974	80	89.096	105	71.776	130	60.205	155	51.913	180	45.674
6	344.263	31	172.754	56	116.452	81	88.239	106	71.226	131	59.821	156	51.630	181	45.456
7	330.843	32	169.439	57	114.969	82	87.399	107	70.684	132	59.442	157	51.350	182	45.240
8	318.456	33	166.252	58	113.525	83	86.575	108	70.151	133	59.068	158	51.073	183	45.027
9	306.988	34	163.186	59	112.118	84	85.767	109	69.626	134	58.699	159	50.799	184	44.815
10	296.338	35	160.234	60	110.747	85	84.974	110	69.109	135	58.335	160	50.529	185	44.606
11	286.422	36	157.390	61	109.409	86	84.196	111	68.599	136	57.975	161	50.261	186	44.398
12	277.166	37	154.648	62	108.104	87	83.433	112	68.098	137	57.620	162	49.996	187	44.193
13	268.505	38	152.002	63	106.831	88	82.684	113	67.604	138	57.269	163	49.734	188	43.990
14	260.383	39	149.448	64	105.588	89	81.949	114	67.117	139	56.923	164	49.474	189	43.788
15	252.751	40	146.981	65	104.375	90	81.226	115	66.637	140	56.581	165	49.218	190	43.588
16	245.566	41	144.596	66	103.190	91	80.517	116	66.165	141	56.243	166	48.964	191	43.391
17	238.789	42	142.290	67	102.033	92	79.821	117	65.699	142	55.909	167	48.713	192	43.195
18	232.385	43	140.058	68	100.902	93	79.137	118	65.240	143	55.579	168	48.464	193	43.000
19	226.326	44	137.896	69	99.796	94	78.464	119	64.787	144	55.254	169	48.218	194	42.808
20	220.583	45	135.803	70	98.715	95	77.804	120	64.341	145	54.932	170	47.975	195	42.617
21	215.132	46	133.773	71	97.658	96	77.154	121	63.901	146	54.614	171	47.734	196	42.429
22	209.951	47	131.806	72	96.624	97	76.516	122	63.468	147	54.299	172	47.496	197	42.241
23	205.021	48	129.896	73	95.612	98	75.889	123	63.040	148	53.989	173	47.260	198	42.056
24	200.323	49	128.043	74	94.622	99	75.272	124	62.618	149	53.682	174	47.026	199	41.872
25	195.841	50	126.244	75	93.652	100	74.665	125	62.202	150	53.379	175	46.795	200	41.690

P=0.5(年)

t: 分钟; q: 升/秒/公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	475.992	26	214.113	51	140.825	76	105.806	101	85.142	126	71.451	151	61.686	176	54.355
2	452.885	27	209.656	52	138.959	77	104.778	102	84.489	127	70.998	152	61.353	177	54.100
3	432.013	28	205.390	53	137.144	78	103.771	103	83.846	128	70.551	153	61.024	178	53.847
4	413.061	29	201.301	54	135.379	79	102.784	104	83.214	129	70.110	154	60.698	179	53.596
5	395.774	30	197.380	55	133.660	80	101.816	105	82.591	130	69.675	155	60.376	180	53.348
6	379.937	31	193.616	56	131.987	81	100.868	106	81.979	131	69.246	156	60.058	181	53.102
7	365.374	32	189.999	57	130.357	82	99.937	107	81.375	132	68.822	157	59.743	182	52.859
8	351.934	33	186.521	58	128.769	83	99.025	108	80.781	133	68.403	158	59.431	183	52.618
9	339.492	34	183.174	59	127.221	84	98.129	109	80.196	134	67.990	159	59.123	184	52.379
10	327.937	35	179.950	60	125.711	85	97.251	110	79.619	135	67.582	160	58.819	185	52.142
11	317.178	36	176.843	61	124.238	86	96.389	111	79.052	136	67.179	161	58.517	186	51.908
12	307.133	37	173.847	62	122.801	87	95.543	112	78.493	137	66.781	162	58.219	187	51.676
13	297.734	38	170.955	63	121.399	88	94.712	113	77.941	138	66.388	163	57.924	188	51.446
14	288.918	39	168.163	64	120.029	89	93.896	114	77.399	139	65.999	164	57.632	189	51.218
15	280.633	40	165.464	65	118.692	90	93.095	115	76.863	140	65.616	165	57.343	190	50.993
16	272.830	41	162.855	66	117.386	91	92.308	116	76.336	141	65.237	166	57.057	191	50.769
17	265.470	42	160.330	67	116.109	92	91.535	117	75.816	142	64.863	167	56.775	192	50.548
18	258.514	43	157.886	68	114.861	93	90.775	118	75.304	143	64.493	168	56.495	193	50.328
19	251.929	44	155.519	69	113.641	94	90.028	119	74.798	144	64.127	169	56.218	194	50.111
20	245.687	45	153.226	70	112.448	95	89.295	120	74.300	145	63.766	170	55.943	195	49.895
21	239.761	46	151.002	71	111.281	96	88.573	121	73.809	146	63.409	171	55.672	196	49.681
22	234.126	47	148.844	72	110.139	97	87.864	122	73.324	147	63.056	172	55.403	197	49.470
23	228.763	48	146.751	73	109.021	98	87.167	123	72.846	148	62.708	173	55.137	198	49.260
24	223.651	49	144.718	74	107.927	99	86.481	124	72.375	149	62.363	174	54.874	199	49.052
25	218.773	50	142.743	75	106.856	100	85.806	125	71.910	150	62.023	175	54.613	200	48.846

P=1 (年)

t: 分钟; q: 升/秒/公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	546.967	26	252.013	51	168.658	76	128.365	101	104.355	126	88.316	151	76.795	176	68.093
2	520.914	27	246.969	52	166.522	77	127.175	102	103.593	127	87.784	152	76.401	177	67.789
3	497.400	28	242.138	53	164.442	78	126.009	103	102.842	128	87.258	153	76.011	178	67.488
4	476.064	29	237.507	54	162.419	79	124.866	104	102.103	129	86.739	154	75.626	179	67.189
5	456.609	30	233.062	55	160.448	80	123.745	105	101.376	130	86.227	155	75.244	180	66.894
6	438.794	31	228.794	56	158.528	81	122.645	106	100.660	131	85.721	156	74.867	181	66.601
7	422.414	32	224.690	57	156.657	82	121.567	107	99.954	132	85.221	157	74.494	182	66.311
8	407.299	33	220.743	58	154.833	83	120.508	108	99.259	133	84.728	158	74.124	183	66.023
9	393.306	34	216.942	59	153.054	84	119.469	109	98.574	134	84.241	159	73.759	184	65.738
10	380.310	35	213.279	60	151.319	85	118.450	110	97.900	135	83.760	160	73.398	185	65.456
11	368.208	36	209.748	61	149.625	86	117.449	111	97.235	136	83.285	161	73.040	186	65.177
12	356.907	37	206.340	62	147.972	87	116.466	112	96.580	137	82.815	162	72.686	187	64.900
13	346.329	38	203.050	63	146.358	88	115.500	113	95.935	138	82.352	163	72.336	188	64.626
14	336.406	39	199.870	64	144.782	89	114.552	114	95.298	139	81.894	164	71.989	189	64.354
15	327.076	40	196.797	65	143.242	90	113.621	115	94.671	140	81.441	165	71.646	190	64.084
16	318.288	41	193.823	66	141.736	91	112.705	116	94.053	141	80.994	166	71.307	191	63.817
17	309.994	42	190.945	67	140.265	92	111.806	117	93.443	142	80.552	167	70.971	192	63.553
18	302.153	43	188.158	68	138.826	93	110.921	118	92.842	143	80.115	168	70.638	193	63.290
19	294.728	44	185.457	69	137.418	94	110.052	119	92.249	144	79.683	169	70.309	194	63.030
20	287.686	45	182.838	70	136.041	95	109.197	120	91.664	145	79.256	170	69.983	195	62.773
21	280.998	46	180.298	71	134.693	96	108.357	121	91.087	146	78.834	171	69.660	196	62.517
22	274.636	47	177.833	72	133.374	97	107.530	122	90.518	147	78.417	172	69.341	197	62.264
23	268.577	48	175.440	73	132.083	98	106.717	123	89.956	148	78.005	173	69.024	198	62.013
24	262.800	49	173.115	74	130.818	99	105.917	124	89.402	149	77.597	174	68.711	199	61.764
25	257.284	50	170.855	75	129.579	100	105.130	125	88.856	150	77.194	175	68.401	200	61.518

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	t	q
1	629.370	26	289.065	51	195.578	76	150.351	101	123.280	126	105.104	151	91.984	176	82.027
2	598.380	27	283.395	52	193.183	77	149.012	102	122.418	127	104.499	152	91.534	177	81.678
3	570.595	28	277.968	53	190.852	78	147.700	103	121.569	128	103.902	153	91.089	178	81.333
4	545.529	29	272.766	54	188.583	79	146.414	104	120.734	129	103.312	154	90.648	179	80.990
5	522.789	30	267.776	55	186.374	80	145.152	105	119.911	130	102.730	155	90.213	180	80.651
6	502.058	31	262.985	56	184.221	81	143.913	106	119.100	131	102.154	156	89.781	181	80.315
7	483.072	32	258.381	57	182.122	82	142.699	107	118.301	132	101.586	157	89.355	182	79.982
8	465.615	33	253.953	58	180.077	83	141.507	108	117.515	133	101.025	158	88.933	183	79.652
9	449.503	34	249.690	59	178.081	84	140.336	109	116.740	134	100.471	159	88.515	184	79.325
10	434.582	35	245.584	60	176.135	85	139.187	110	115.976	135	99.923	160	88.102	185	79.001
11	420.721	36	241.624	61	174.235	86	138.059	111	115.223	136	99.382	161	87.693	186	78.680
12	407.807	37	237.804	62	172.380	87	136.951	112	114.481	137	98.848	162	87.288	187	78.362
13	395.744	38	234.117	63	170.568	88	135.863	113	113.749	138	98.320	163	86.887	188	78.047
14	384.448	39	230.554	64	168.798	89	134.794	114	113.028	139	97.798	164	86.491	189	77.734
15	373.846	40	227.109	65	167.069	90	133.743	115	112.317	140	97.282	165	86.098	190	77.424
16	363.873	41	223.777	66	165.379	91	132.710	116	111.616	141	96.773	166	85.710	191	77.117
17	354.475	42	220.553	67	163.726	92	131.695	117	110.925	142	96.269	167	85.325	192	76.813
18	345.600	43	217.429	68	162.110	93	130.697	118	110.243	143	95.771	168	84.944	193	76.511
19	337.205	44	214.403	69	160.528	94	129.716	119	109.570	144	95.279	169	84.567	194	76.212
20	329.251	45	211.469	70	158.981	95	128.751	120	108.906	145	94.792	170	84.193	195	75.916
21	321.704	46	208.623	71	157.467	96	127.802	121	108.251	146	94.311	171	83.824	196	75.622
22	314.531	47	205.860	72	155.984	97	126.868	122	107.605	147	93.835	172	83.457	197	75.331
23	307.705	48	203.178	73	154.532	98	125.950	123	106.968	148	93.364	173	83.095	198	75.042
24	301.200	49	200.573	74	153.110	99	125.046	124	106.338	149	92.899	174	82.736	199	74.756
25	294.994	50	198.040	75	151.716	100	124.156	125	105.717	150	92.439	175	82.380	200	74.472

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	t	q
1	677.197	26	310.698	51	211.568	76	163.572	101	134.767	126	115.370	151	101.329	176	90.646
2	643.237	27	304.680	52	209.029	77	162.149	102	133.848	127	114.723	152	100.847	177	90.271
3	612.908	28	298.920	53	206.557	78	160.755	103	132.943	128	114.085	153	100.370	178	89.900
4	585.639	29	293.401	54	204.151	79	159.387	104	132.052	129	113.454	154	99.898	179	89.532
5	560.974	30	288.108	55	201.808	80	158.045	105	131.175	130	112.831	155	99.430	180	89.167
6	538.545	31	283.027	56	199.524	81	156.729	106	130.311	131	112.216	156	98.968	181	88.806
7	518.051	32	278.144	57	197.299	82	155.437	107	129.459	132	111.609	157	98.511	182	88.448
8	499.245	33	273.448	58	195.129	83	154.170	108	128.620	133	111.009	158	98.058	183	88.093
9	481.918	34	268.929	59	193.012	84	152.925	109	127.793	134	110.416	159	97.610	184	87.742
10	465.897	35	264.575	60	190.947	85	151.703	110	126.978	135	109.830	160	97.167	185	87.393
11	451.036	36	260.377	61	188.931	86	150.503	111	126.175	136	109.251	161	96.728	186	87.048
12	437.207	37	256.328	62	186.963	87	149.324	112	125.383	137	108.679	162	96.294	187	86.706
13	424.304	38	252.419	63	185.040	88	148.166	113	124.603	138	108.114	163	95.864	188	86.367
14	412.233	39	248.642	64	183.162	89	147.028	114	123.833	139	107.556	164	95.439	189	86.031
15	400.914	40	244.992	65	181.327	90	145.910	115	123.074	140	107.004	165	95.017	190	85.698
16	390.276	41	241.460	66	179.532	91	144.811	116	122.326	141	106.458	166	94.600	191	85.367
17	380.257	42	238.042	67	177.778	92	143.730	117	121.587	142	105.919	167	94.187	192	85.040
18	370.803	43	234.731	68	176.062	93	142.668	118	120.859	143	105.386	168	93.778	193	84.715
19	361.865	44	231.524	69	174.383	94	141.623	119	120.141	144	104.859	169	93.373	194	84.394
20	353.402	45	228.414	70	172.740	95	140.595	120	119.432	145	104.337	170	92.972	195	84.075
21	345.374	46	225.397	71	171.131	96	139.584	121	118.733	146	103.822	171	92.575	196	83.758
22	337.749	47	222.468	72	169.556	97	138.590	122	118.042	147	103.312	172	92.182	197	83.445
23	330.494	48	219.625	73	168.014	98	137.611	123	117.361	148	102.808	173	91.793	198	83.134
24	323.584	49	216.863	74	166.503	99	136.648	124	116.689	149	102.310	174	91.407	199	82.825
25	316.993	50	214.178	75	165.023	100	135.700	125	116.025	150	101.817	175	91.025	200	82.520

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	t	q
1	737.145	26	337.583	51	231.689	76	180.373	101	149.476	126	128.598	151	113.434	176	101.860
2	699.265	27	331.146	52	228.977	77	178.849	102	148.489	127	127.901	152	112.912	177	101.453
3	665.613	28	324.986	53	226.338	78	177.355	103	147.516	128	127.212	153	112.396	178	101.050
4	635.493	29	319.086	54	223.767	79	175.890	104	146.559	129	126.532	154	111.885	179	100.650
5	608.356	30	313.429	55	221.264	80	174.453	105	145.615	130	125.860	155	111.379	180	100.255
6	583.764	31	307.999	56	218.825	81	173.042	106	144.686	131	125.196	156	110.879	181	99.862
7	561.360	32	302.782	57	216.447	82	171.658	107	143.770	132	124.541	157	110.384	182	99.474
8	540.855	33	297.766	58	214.128	83	170.299	108	142.868	133	123.893	158	109.894	183	99.089
9	522.007	34	292.938	59	211.866	84	168.965	109	141.978	134	123.253	159	109.409	184	98.707
10	504.615	35	288.288	60	209.658	85	167.655	110	141.101	135	122.621	160	108.929	185	98.328
11	488.511	36	283.806	61	207.503	86	166.368	111	140.237	136	121.996	161	108.454	186	97.953
12	473.551	37	279.482	62	205.399	87	165.104	112	139.385	137	121.378	162	107.983	187	97.582
13	459.612	38	275.307	63	203.344	88	163.862	113	138.545	138	120.768	163	107.517	188	97.213
14	446.589	39	271.275	64	201.336	89	162.641	114	137.716	139	120.165	164	107.056	189	96.848
15	434.391	40	267.377	65	199.373	90	161.441	115	136.899	140	119.569	165	106.600	190	96.486
16	422.939	41	263.607	66	197.454	91	160.262	116	136.093	141	118.979	166	106.148	191	96.127
17	412.163	42	259.957	67	195.577	92	159.102	117	135.298	142	118.396	167	105.700	192	95.771
18	402.004	43	256.423	68	193.742	93	157.962	118	134.514	143	117.820	168	105.257	193	95.418
19	392.407	44	252.998	69	191.945	94	156.840	119	133.740	144	117.250	169	104.818	194	95.069
20	383.325	45	249.677	70	190.187	95	155.737	120	132.976	145	116.687	170	104.383	195	94.722
21	374.717	46	246.456	71	188.466	96	154.651	121	132.223	146	116.130	171	103.953	196	94.378
22	366.544	47	243.330	72	186.780	97	153.583	122	131.479	147	115.579	172	103.526	197	94.037
23	358.772	48	240.294	73	185.129	98	152.532	123	130.745	148	115.034	173	103.104	198	93.698
24	351.373	49	237.344	74	183.512	99	151.497	124	130.020	149	114.495	174	102.685	199	93.363
25	344.318	50	234.477	75	181.926	100	150.479	125	129.305	150	113.962	175	102.271	200	93.030

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	t	q
1	820.548	26	374.835	51	260.101	76	204.422	101	170.749	126	147.886	151	131.204	176	118.417
2	776.859	27	367.849	52	257.163	77	202.765	102	169.670	127	147.120	152	130.628	177	117.967
3	738.356	28	361.166	53	254.303	78	201.140	103	168.607	128	146.364	153	130.059	178	117.520
4	704.128	29	354.767	54	251.518	79	199.546	104	167.560	129	145.617	154	129.495	179	117.078
5	673.469	30	348.633	55	248.805	80	197.982	105	166.529	130	144.879	155	128.938	180	116.640
6	645.824	31	342.747	56	246.161	81	196.446	106	165.512	131	144.150	156	128.386	181	116.205
7	620.750	32	337.094	57	243.583	82	194.940	107	164.511	132	143.429	157	127.839	182	115.774
8	597.887	33	331.659	58	241.069	83	193.460	108	163.523	133	142.717	158	127.298	183	115.348
9	576.942	34	326.429	59	238.616	84	192.007	109	162.550	134	142.014	159	126.763	184	114.924
10	557.673	35	321.392	60	236.222	85	190.580	110	161.590	135	141.319	160	126.233	185	114.505
11	539.876	36	316.538	61	233.885	86	189.178	111	160.644	136	140.632	161	125.708	186	114.089
12	523.381	37	311.855	62	231.603	87	187.801	112	159.712	137	139.953	162	125.189	187	113.677
13	508.044	38	307.335	63	229.373	88	186.447	113	158.792	138	139.281	163	124.674	188	113.268
14	493.741	39	302.969	64	227.194	89	185.116	114	157.884	139	138.618	164	124.165	189	112.863
15	480.366	40	298.748	65	225.063	90	183.808	115	156.989	140	137.961	165	123.660	190	112.462
16	467.827	41	294.666	66	222.980	91	182.522	116	156.106	141	137.313	166	123.161	191	112.063
17	456.044	42	290.714	67	220.943	92	181.257	117	155.235	142	136.671	167	122.666	192	111.669
18	444.948	43	286.887	68	218.949	93	180.013	118	154.375	143	136.037	168	122.176	193	111.277
19	434.477	44	283.179	69	216.998	94	178.789	119	153.527	144	135.409	169	121.690	194	110.889
20	424.578	45	279.583	70	215.089	95	177.585	120	152.689	145	134.789	170	121.209	195	110.504
21	415.202	46	276.095	71	213.219	96	176.401	121	151.863	146	134.175	171	120.733	196	110.122
22	406.307	47	272.710	72	211.387	97	175.235	122	151.047	147	133.568	172	120.261	197	109.743
23	397.855	48	269.422	73	209.593	98	174.087	123	150.242	148	132.967	173	119.794	198	109.367
24	389.812	49	266.227	74	207.834	99	172.957	124	149.447	149	132.373	174	119.331	199	108.995
25	382.148	50	263.122	75	206.111	100	171.844	125	148.661	150	131.786	175	118.872	200	108.625

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	t	q
1	962.895	26	412.848	51	289.002	76	229.768	101	193.963	126	169.572	151	151.697	176	137.931
2	901.417	27	405.196	52	285.869	77	228.008	102	192.814	127	168.753	152	151.079	177	137.445
3	848.993	28	397.893	53	282.820	78	226.282	103	191.682	128	167.945	153	150.467	178	136.963
4	803.657	29	390.914	54	279.853	79	224.588	104	190.567	129	167.145	154	149.861	179	136.485
5	763.987	30	384.237	55	276.963	80	222.925	105	189.468	130	166.356	155	149.262	180	136.011
6	728.926	31	377.842	56	274.147	81	221.294	106	188.384	131	165.576	156	148.668	181	135.542
7	697.671	32	371.709	57	271.403	82	219.693	107	187.317	132	164.805	157	148.081	182	135.077
8	669.600	33	365.822	58	268.727	83	218.120	108	186.265	133	164.043	158	147.499	183	134.616
9	644.222	34	360.166	59	266.117	84	216.576	109	185.227	134	163.289	159	146.923	184	134.158
10	621.146	35	354.725	60	263.570	85	215.059	110	184.204	135	162.545	160	146.353	185	133.705
11	600.054	36	349.488	61	261.084	86	213.569	111	183.195	136	161.809	161	145.788	186	133.255
12	580.685	37	344.443	62	258.656	87	212.104	112	182.200	137	161.082	162	145.229	187	132.810
13	562.824	38	339.578	63	256.285	88	210.665	113	181.219	138	160.362	163	144.675	188	132.368
14	546.291	39	334.883	64	253.968	89	209.250	114	180.251	139	159.651	164	144.126	189	131.929
15	530.935	40	330.349	65	251.704	90	207.859	115	179.296	140	158.948	165	143.583	190	131.495
16	516.627	41	325.967	66	249.489	91	206.491	116	178.353	141	158.252	166	143.045	191	131.064
17	503.256	42	321.730	67	247.324	92	205.146	117	177.423	142	157.564	167	142.512	192	130.636
18	490.728	43	317.629	68	245.205	93	203.823	118	176.505	143	156.884	168	141.984	193	130.213
19	478.960	44	313.658	69	243.132	94	202.521	119	175.599	144	156.211	169	141.461	194	129.792
20	467.881	45	309.810	70	241.103	95	201.240	120	174.705	145	155.545	170	140.942	195	129.375
21	457.429	46	306.080	71	239.116	96	199.979	121	173.822	146	154.887	171	140.429	196	128.961
22	447.548	47	302.461	72	237.170	97	198.738	122	172.951	147	154.235	172	139.920	197	128.551
23	438.191	48	298.949	73	235.263	98	197.516	123	172.090	148	153.591	173	139.416	198	128.144
24	429.313	49	295.538	74	233.395	99	196.314	124	171.241	149	152.953	174	138.916	199	127.740
25	420.877	50	292.224	75	231.564	100	195.129	125	170.401	150	152.322	175	138.421	200	127.340

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	t	q
1	1106.052	26	453.756	51	322.001	76	259.292	101	221.249	126	195.198	151	176.001	176	161.140
2	1024.053	27	445.551	52	318.685	77	257.425	102	220.024	127	194.320	152	175.335	177	160.613
3	956.512	28	437.731	53	315.459	78	255.594	103	218.818	128	193.454	153	174.676	178	160.092
4	899.696	29	430.267	54	312.319	79	253.798	104	217.629	129	192.597	154	174.024	179	159.574
5	851.086	30	423.134	55	309.261	80	252.034	105	216.458	130	191.751	155	173.377	180	159.062
6	808.914	31	416.309	56	306.281	81	250.304	106	215.303	131	190.914	156	172.738	181	158.553
7	771.900	32	409.770	57	303.378	82	248.604	107	214.164	132	190.087	157	172.104	182	158.049
8	739.091	33	403.498	58	300.546	83	246.935	108	213.041	133	189.270	158	171.477	183	157.549
9	709.761	34	397.476	59	297.784	84	245.296	109	211.934	134	188.462	159	170.856	184	157.053
10	683.349	35	391.689	60	295.089	85	243.685	110	210.842	135	187.663	160	170.241	185	156.562
11	659.409	36	386.122	61	292.458	86	242.102	111	209.765	136	186.873	161	169.631	186	156.074
12	637.587	37	380.761	62	289.889	87	240.547	112	208.703	137	186.092	162	169.028	187	155.591
13	617.594	38	375.594	63	287.379	88	239.018	113	207.655	138	185.320	163	168.430	188	155.112
14	599.193	39	370.611	64	284.927	89	237.514	114	206.621	139	184.556	164	167.838	189	154.636
15	582.187	40	365.801	65	282.529	90	236.036	115	205.600	140	183.800	165	167.251	190	154.164
16	566.412	41	361.154	66	280.185	91	234.582	116	204.593	141	183.053	166	166.670	191	153.697
17	551.731	42	356.661	67	277.892	92	233.151	117	203.599	142	182.314	167	166.094	192	153.233
18	538.024	43	352.315	68	275.649	93	231.744	118	202.617	143	181.582	168	165.523	193	152.772
19	525.191	44	348.107	69	273.453	94	230.359	119	201.649	144	180.859	169	164.958	194	152.316
20	513.144	45	344.031	70	271.303	95	228.996	120	200.692	145	180.143	170	164.398	195	151.863
21	501.809	46	340.080	71	269.198	96	227.655	121	199.748	146	179.435	171	163.842	196	151.413
22	491.119	47	336.248	72	267.136	97	226.334	122	198.815	147	178.734	172	163.292	197	150.967
23	481.016	48	332.530	73	265.116	98	225.033	123	197.894	148	178.040	173	162.747	198	150.525
24	471.451	49	328.919	74	263.136	99	223.753	124	196.984	149	177.353	174	162.206	199	150.086
25	462.377	50	325.411	75	261.195	100	222.491	125	196.085	150	176.674	175	161.671	200	149.651

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	t	q
1	1208.843	26	478.553	51	343.101	76	278.784	101	239.652	126	212.752	151	192.855	176	177.395
2	1107.794	27	470.077	52	339.702	77	276.867	102	238.390	127	211.845	152	192.163	177	176.846
3	1027.194	28	462.006	53	336.395	78	274.987	103	237.146	128	210.948	153	191.478	178	176.302
4	961.032	29	454.308	54	333.176	79	273.141	104	235.920	129	210.061	154	190.800	179	175.763
5	905.500	30	446.956	55	330.041	80	271.329	105	234.712	130	209.185	155	190.129	180	175.228
6	858.058	31	439.926	56	326.987	81	269.551	106	233.521	131	208.319	156	189.464	181	174.698
7	816.936	32	433.195	57	324.010	82	267.804	107	232.346	132	207.463	157	188.806	182	174.172
8	780.863	33	426.743	58	321.107	83	266.089	108	231.188	133	206.616	158	188.154	183	173.651
9	748.896	34	420.550	59	318.276	84	264.403	109	230.046	134	205.779	159	187.508	184	173.134
10	720.319	35	414.602	60	315.512	85	262.747	110	228.919	135	204.951	160	186.868	185	172.621
11	694.581	36	408.881	61	312.815	86	261.120	111	227.807	136	204.133	161	186.235	186	172.112
12	671.246	37	403.374	62	310.180	87	259.520	112	226.710	137	203.324	162	185.607	187	171.608
13	649.967	38	398.069	63	307.606	88	257.947	113	225.628	138	202.523	163	184.985	188	171.107
14	630.464	39	392.953	64	305.091	89	256.400	114	224.560	139	201.731	164	184.369	189	170.611
15	612.505	40	388.016	65	302.632	90	254.879	115	223.506	140	200.948	165	183.759	190	170.118
16	595.899	41	383.248	66	300.228	91	253.383	116	222.466	141	200.173	166	183.154	191	169.630
17	580.486	42	378.639	67	297.875	92	251.911	117	221.439	142	199.406	167	182.554	192	169.145
18	566.134	43	374.181	68	295.574	93	250.462	118	220.425	143	198.648	168	181.960	193	168.665
19	552.726	44	369.865	69	293.321	94	249.037	119	219.423	144	197.897	169	181.372	194	168.188
20	540.164	45	365.685	70	291.115	95	247.633	120	218.435	145	197.154	170	180.788	195	167.714
21	528.366	46	361.634	71	288.955	96	246.252	121	217.458	146	196.419	171	180.210	196	167.245
22	517.257	47	357.706	72	286.838	97	244.891	122	216.494	147	195.692	172	179.637	197	166.779
23	506.774	48	353.893	73	284.764	98	243.552	123	215.541	148	194.971	173	179.069	198	166.317
24	496.861	49	350.192	74	282.732	99	242.232	124	214.601	149	194.259	174	178.506	199	165.858
25	487.468	50	346.596	75	280.739	100	240.932	125	213.671	150	193.553	175	177.948	200	165.403