

# 东莞市暴雨强度公式及计算图表

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## 说

1. 本计算图表以东莞国家气象观测站 36 年(1980~2015 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:

$$q = \frac{3717.342 \times (1 + 0.503LgP)}{(t + 14.533)^{0.729}}$$

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:

$$n = 0.781 - 0.034 \ln(P - 5.632)$$

$$= 0.680237 \text{ (取 } 0.680 \text{)}$$

$$b = 7.343 - 0.447 \ln(P - 6.185)$$

$$= 12.27103 \text{ (取 } 12.271 \text{)}$$

$$A = 13.539 + 0.741 \ln(P - 0.107)$$

$$= 30.14128 \text{ (取 } 30.141 \text{)}$$

配得  $P=25$  年的暴雨强度计算公式如下:

$$q = \frac{167 \times 30.141}{(t + 12.271)^{0.680}}$$

可按上式计算 1~180 分钟中任何时段的暴雨强度。

当  $t=50$ :

$$q = \frac{167 \times 30.141}{(50 + 12.271)^{0.680}} = 303.221 \text{ [升/(秒·公顷)]}$$

## 5. 公式误差

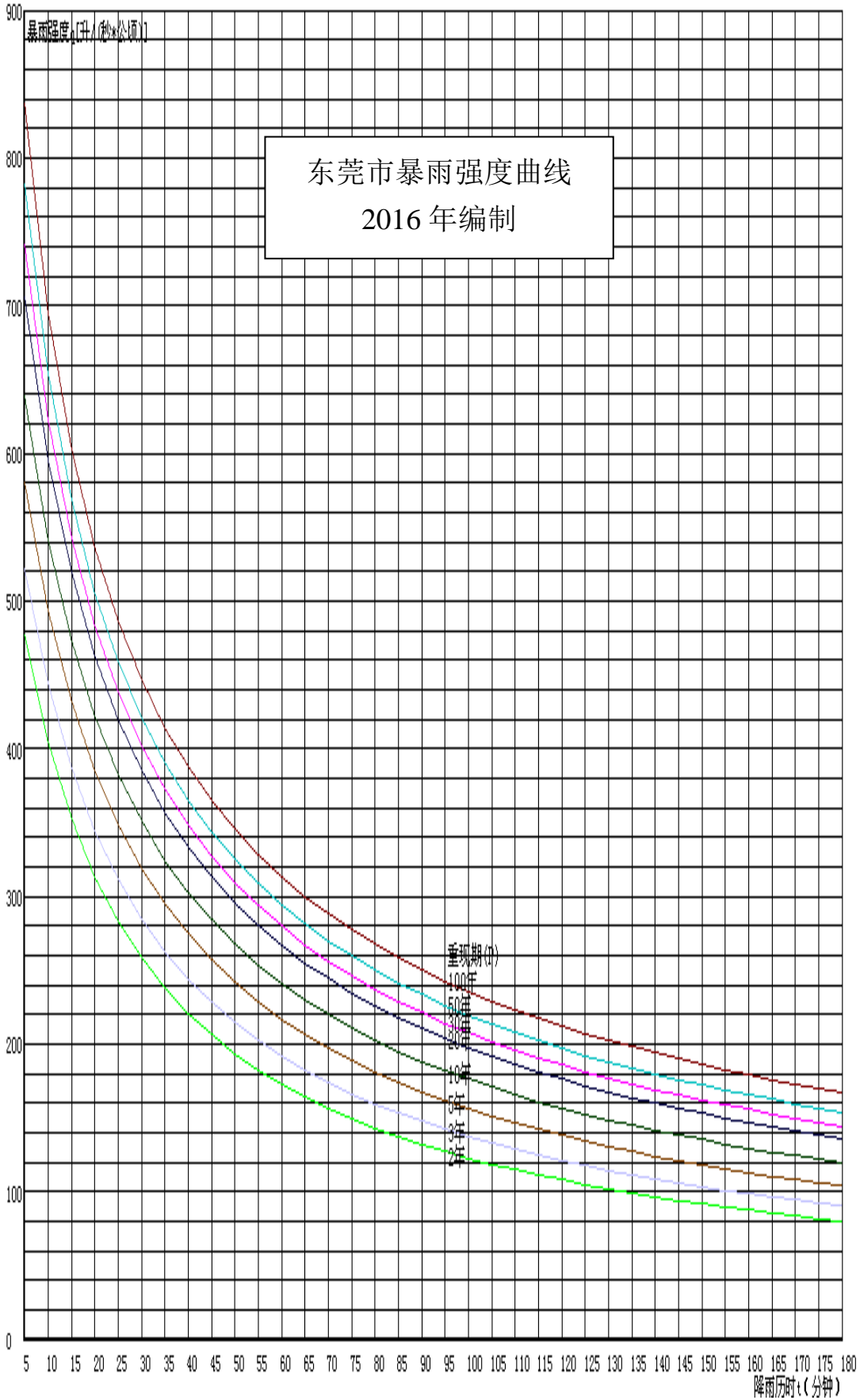
重现期 2~20 年的暴雨强度公式算得的平均绝对均方差为: 0.034 (mm/min), 平均相对均方差为: 2.23%。精度符合《室外排水设计规范》(GB50014—2006, 2014 年版) 提出的要求。

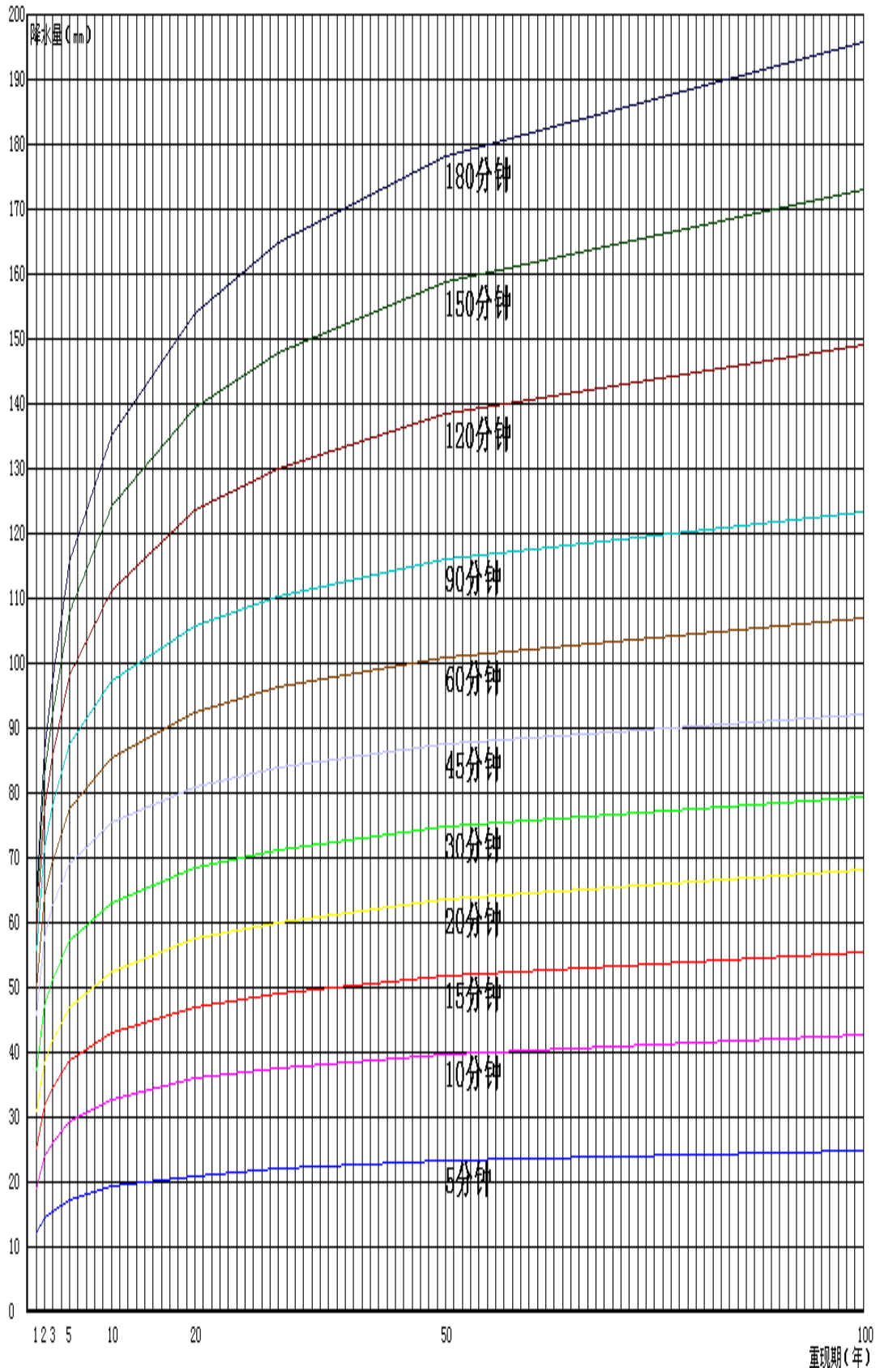
表一 单一重现期暴雨强度公式

重现期 P (年)	公 式
P=2	$6088.319 / (t + 17.391)^{0.819}$
P=3	$6237.617 / (t + 17.115)^{0.801}$
P=5	$6401.110 / (t + 16.727)^{0.780}$
P=10	$5642.262 / (t + 14.685)^{0.731}$
P=20	$5146.606 / (t + 12.783)^{0.690}$
P=30	$4948.043 / (t + 11.871)^{0.672}$
P=40	$4821.791 / (t + 11.265)^{0.661}$
P=50	$4728.772 / (t + 10.811)^{0.652}$
P=60	$4655.292 / (t + 10.447)^{0.645}$
P=70	$4594.504 / (t + 10.144)^{0.639}$
P=80	$4542.734 / (t + 9.883)^{0.634}$
P=90	$4497.477 / (t + 9.656)^{0.630}$
P=100	$4457.397 / (t + 9.453)^{0.626}$

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	$0.837 - 0.037\text{Ln}(P - 0.378)$
		b	$18.442 - 0.957\text{Ln}(P + 1.000)$
		A	$36.054 + 1.562\text{Ln}(P - 0.706)$
10—100	II	n	$0.781 - 0.034\text{Ln}(P - 5.632)$
		b	$17.796 - 1.830\text{Ln}(P - 4.527)$
		A	$36.288 - 2.116\text{Ln}(P - 6.737)$





各历时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	560.771	27	272.498	53	186.802	79	144.401	105	118.749	131	101.418	157	88.856
2	536.973	28	267.571	54	184.656	80	143.186	106	117.960	132	100.862	158	88.441
3	515.308	29	262.838	55	182.564	81	141.993	107	117.183	133	100.312	159	88.031
4	495.494	30	258.287	56	180.524	82	140.822	108	116.417	134	99.769	160	87.624
5	477.295	31	253.907	57	178.535	83	139.672	109	115.662	135	99.232	161	87.221
6	460.518	32	249.689	58	176.593	84	138.543	110	114.918	136	98.702	162	86.823
7	444.996	33	245.624	59	174.697	85	137.434	111	114.185	137	98.178	163	86.429
8	430.591	34	241.702	60	172.846	86	136.344	112	113.461	138	97.661	164	86.038
9	417.182	35	237.917	61	171.038	87	135.273	113	112.748	139	97.149	165	85.652
10	404.666	36	234.262	62	169.272	88	134.221	114	112.045	140	96.643	166	85.269
11	392.955	37	230.728	63	167.545	89	133.187	115	111.351	141	96.143	167	84.890
12	381.971	38	227.311	64	165.858	90	132.171	116	110.667	142	95.649	168	84.515
13	371.646	39	224.004	65	164.207	91	131.171	117	109.992	143	95.160	169	84.143
14	361.921	40	220.803	66	162.593	92	130.188	118	109.326	144	94.677	170	83.775
15	352.744	41	217.701	67	161.013	93	129.221	119	108.670	145	94.199	171	83.411
16	344.068	42	214.694	68	159.467	94	128.271	120	108.021	146	93.727	172	83.050
17	335.853	43	211.778	69	157.954	95	127.335	121	107.382	147	93.260	173	82.693
18	328.061	44	208.949	70	156.472	96	126.415	122	106.750	148	92.797	174	82.339
19	320.659	45	206.202	71	155.021	97	125.509	123	106.127	149	92.340	175	81.988
20	313.618	46	203.534	72	153.599	98	124.617	124	105.512	150	91.888	176	81.641
21	306.912	47	200.941	73	152.206	99	123.740	125	104.905	151	91.441	177	81.296
22	300.516	48	198.421	74	150.840	100	122.876	126	104.305	152	90.999	178	80.956
23	294.408	49	195.970	75	149.502	101	122.025	127	103.713	153	90.561	179	80.618
24	288.570	50	193.585	76	148.190	102	121.187	128	103.129	154	90.128	180	80.283
25	282.983	51	191.264	77	146.903	103	120.362	129	102.551	155	89.700	181	79.952
26	277.630	52	189.004	78	145.640	104	119.550	130	101.981	156	89.276	182	79.623

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	612.816	27	300.404	53	207.264	79	160.992	105	132.897	131	113.859	157	100.025
2	587.000	28	295.058	54	204.926	80	159.662	106	132.032	132	113.247	158	99.567
3	563.507	29	289.922	55	202.647	81	158.358	107	131.179	133	112.643	159	99.114
4	542.027	30	284.982	56	200.424	82	157.076	108	130.339	134	112.045	160	98.666
5	522.305	31	280.228	57	198.255	83	155.818	109	129.510	135	111.455	161	98.222
6	504.127	32	275.649	58	196.138	84	154.583	110	128.694	136	110.871	162	97.782
7	487.311	33	271.234	59	194.071	85	153.369	111	127.888	137	110.295	163	97.347
8	471.707	34	266.976	60	192.053	86	152.177	112	127.094	138	109.725	164	96.916
9	457.183	35	262.864	61	190.081	87	151.005	113	126.311	139	109.162	165	96.490
10	443.627	36	258.893	62	188.154	88	149.853	114	125.539	140	108.605	166	96.068
11	430.942	37	255.053	63	186.270	89	148.721	115	124.777	141	108.054	167	95.649
12	419.045	38	251.340	64	184.429	90	147.608	116	124.026	142	107.510	168	95.235
13	407.862	39	247.746	65	182.628	91	146.513	117	123.285	143	106.972	169	94.825
14	397.329	40	244.265	66	180.865	92	145.436	118	122.553	144	106.439	170	94.419
15	387.388	41	240.893	67	179.141	93	144.378	119	121.832	145	105.913	171	94.017
16	377.989	42	237.623	68	177.453	94	143.336	120	121.119	146	105.393	172	93.618
17	369.088	43	234.452	69	175.801	95	142.311	121	120.416	147	104.878	173	93.224
18	360.644	44	231.374	70	174.182	96	141.302	122	119.723	148	104.369	174	92.833
19	352.623	45	228.385	71	172.597	97	140.310	123	119.038	149	103.865	175	92.446
20	344.992	46	225.482	72	171.044	98	139.332	124	118.362	150	103.367	176	92.062
21	337.723	47	222.661	73	169.522	99	138.370	125	117.694	151	102.875	177	91.682
22	330.789	48	219.918	74	168.030	100	137.423	126	117.035	152	102.387	178	91.305
23	324.168	49	217.249	75	166.567	101	136.490	127	116.384	153	101.905	179	90.932
24	317.837	50	214.653	76	165.133	102	135.572	128	115.741	154	101.427	180	90.562
25	311.778	51	212.125	77	163.726	103	134.667	129	115.106	155	100.955	181	90.196
26	305.972	52	209.663	78	162.346	104	133.776	130	114.479	156	100.488	182	89.833

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	679.704	27	336.102	53	233.562	79	182.410	105	151.235	131	130.040	157	114.593
2	651.224	28	330.226	54	230.982	80	180.937	106	150.273	132	129.357	158	114.081
3	625.328	29	324.579	55	228.467	81	179.492	107	149.325	133	128.683	159	113.575
4	601.668	30	319.148	56	226.013	82	178.072	108	148.391	134	128.017	160	113.073
5	579.957	31	313.920	57	223.618	83	176.678	109	147.469	135	127.358	161	112.576
6	559.954	32	308.884	58	221.280	84	175.308	110	146.561	136	126.707	162	112.085
7	541.459	33	304.028	59	218.998	85	173.962	111	145.665	137	126.064	163	111.598
8	524.302	34	299.343	60	216.768	86	172.640	112	144.781	138	125.428	164	111.116
9	508.337	35	294.819	61	214.590	87	171.340	113	143.910	139	124.799	165	110.639
10	493.440	36	290.449	62	212.461	88	170.063	114	143.051	140	124.178	166	110.166
11	479.503	37	286.223	63	210.379	89	168.807	115	142.203	141	123.563	167	109.698
12	466.433	38	282.136	64	208.344	90	167.572	116	141.367	142	122.955	168	109.235
13	454.148	39	278.179	65	206.353	91	166.357	117	140.541	143	122.355	169	108.776
14	442.578	40	274.346	66	204.404	92	165.163	118	139.727	144	121.760	170	108.321
15	431.659	41	270.632	67	202.498	93	163.988	119	138.923	145	121.173	171	107.871
16	421.336	42	267.031	68	200.631	94	162.831	120	138.130	146	120.592	172	107.425
17	411.560	43	263.537	69	198.803	95	161.693	121	137.347	147	120.017	173	106.983
18	402.286	44	260.146	70	197.013	96	160.573	122	136.575	148	119.448	174	106.545
19	393.476	45	256.853	71	195.259	97	159.471	123	135.812	149	118.885	175	106.111
20	385.094	46	253.653	72	193.540	98	158.386	124	135.058	150	118.329	176	105.682
21	377.109	47	250.543	73	191.856	99	157.317	125	134.314	151	117.778	177	105.256
22	369.492	48	247.519	74	190.204	100	156.265	126	133.580	152	117.233	178	104.834
23	362.217	49	244.577	75	188.585	101	155.229	127	132.854	153	116.694	179	104.416
24	355.261	50	241.713	76	186.997	102	154.208	128	132.138	154	116.161	180	104.002
25	348.602	51	238.925	77	185.439	103	153.202	129	131.430	155	115.633	181	103.591
26	342.222	52	236.209	78	183.910	104	152.212	130	130.731	156	115.110	182	103.185



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	754.317	27	369.188	53	259.038	79	204.250	105	170.768	131	147.910	157	131.179
2	720.996	28	362.846	54	256.276	80	202.671	106	169.732	132	147.172	158	130.623
3	690.962	29	356.755	55	253.582	81	201.121	107	168.712	133	146.443	159	130.073
4	663.731	30	350.901	56	250.955	82	199.598	108	167.705	134	145.722	160	129.528
5	638.911	31	345.270	57	248.391	83	198.102	109	166.713	135	145.010	161	128.989
6	616.182	32	339.848	58	245.888	84	196.633	110	165.735	136	144.306	162	128.455
7	595.279	33	334.623	59	243.444	85	195.189	111	164.770	137	143.610	163	127.926
8	575.981	34	329.585	60	241.057	86	193.770	112	163.818	138	142.922	164	127.402
9	558.102	35	324.723	61	238.725	87	192.375	113	162.879	139	142.241	165	126.883
10	541.483	36	320.027	62	236.445	88	191.004	114	161.953	140	141.568	166	126.370
11	525.990	37	315.489	63	234.216	89	189.655	115	161.039	141	140.903	167	125.861
12	511.507	38	311.100	64	232.036	90	188.329	116	160.137	142	140.245	168	125.357
13	497.935	39	306.853	65	229.904	91	187.025	117	159.247	143	139.595	169	124.858
14	485.185	40	302.741	66	227.818	92	185.742	118	158.369	144	138.951	170	124.363
15	473.182	41	298.757	67	225.776	93	184.479	119	157.502	145	138.314	171	123.873
16	461.860	42	294.895	68	223.776	94	183.237	120	156.647	146	137.685	172	123.388
17	451.159	43	291.150	69	221.819	95	182.014	121	155.802	147	137.062	173	122.907
18	441.026	44	287.515	70	219.901	96	180.811	122	154.968	148	136.445	174	122.430
19	431.417	45	283.985	71	218.022	97	179.626	123	154.144	149	135.835	175	121.958
20	422.289	46	280.557	72	216.180	98	178.459	124	153.331	150	135.232	176	121.490
21	413.605	47	277.225	73	214.375	99	177.310	125	152.528	151	134.635	177	121.027
22	405.333	48	273.985	74	212.606	100	176.179	126	151.734	152	134.044	178	120.567
23	397.442	49	270.833	75	210.870	101	175.064	127	150.951	153	133.459	179	120.112
24	389.906	50	267.766	76	209.168	102	173.966	128	150.177	154	132.880	180	119.661
25	382.699	51	264.780	77	207.498	103	172.885	129	149.412	155	132.307	181	119.213
26	375.800	52	261.872	78	205.859	104	171.818	130	148.656	156	131.740	182	118.770

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	842.120	27	405.256	53	286.433	79	227.622	105	191.635	131	166.995	157	148.900
2	802.389	28	398.373	54	283.466	80	225.927	106	190.520	132	166.198	158	148.298
3	766.955	29	391.770	55	280.574	81	224.262	107	189.421	133	165.411	159	147.701
4	735.125	30	385.428	56	277.753	82	222.627	108	188.338	134	164.632	160	147.111
5	706.346	31	379.333	57	275.001	83	221.020	109	187.269	135	163.863	161	146.526
6	680.179	32	373.468	58	272.314	84	219.442	110	186.215	136	163.102	162	145.947
7	656.265	33	367.820	59	269.691	85	217.891	111	185.176	137	162.350	163	145.374
8	634.311	34	362.377	60	267.129	86	216.367	112	184.151	138	161.606	164	144.806
9	614.073	35	357.127	61	264.625	87	214.868	113	183.139	139	160.871	165	144.244
10	595.346	36	352.059	62	262.178	88	213.395	114	182.141	140	160.143	166	143.686
11	577.959	37	347.164	63	259.786	89	211.946	115	181.157	141	159.424	167	143.135
12	561.765	38	342.433	64	257.447	90	210.521	116	180.185	142	158.713	168	142.588
13	546.639	39	337.856	65	255.159	91	209.119	117	179.226	143	158.009	169	142.046
14	532.474	40	333.426	66	252.920	92	207.740	118	178.279	144	157.313	170	141.509
15	519.174	41	329.136	67	250.728	93	206.383	119	177.345	145	156.624	171	140.978
16	506.660	42	324.979	68	248.582	94	205.047	120	176.422	146	155.943	172	140.451
17	494.860	43	320.948	69	246.481	95	203.733	121	175.511	147	155.269	173	139.929
18	483.711	44	317.037	70	244.423	96	202.439	122	174.611	148	154.602	174	139.411
19	473.158	45	313.241	71	242.406	97	201.165	123	173.723	149	153.942	175	138.899
20	463.152	46	309.555	72	240.430	98	199.910	124	172.846	150	153.289	176	138.391
21	453.648	47	305.972	73	238.492	99	198.674	125	171.979	151	152.642	177	137.887
22	444.608	48	302.490	74	236.593	100	197.457	126	171.123	152	152.003	178	137.388
23	435.997	49	299.103	75	234.730	101	196.258	127	170.278	153	151.369	179	136.893
24	427.784	50	295.808	76	232.902	102	195.077	128	169.442	154	150.743	180	136.403
25	419.939	51	292.600	77	231.109	103	193.913	129	168.617	155	150.122	181	135.917
26	412.438	52	289.476	78	229.349	104	192.765	130	167.801	156	149.508	182	135.435

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	888.739	27	422.868	53	299.734	79	238.986	105	201.806	131	176.324	157	157.586
2	845.156	28	415.711	54	296.668	80	237.234	106	200.654	132	175.499	158	156.962
3	806.531	29	408.848	55	293.680	81	235.515	107	199.518	133	174.684	159	156.344
4	772.018	30	402.261	56	290.765	82	233.826	108	198.398	134	173.879	160	155.732
5	740.960	31	395.931	57	287.921	83	232.167	109	197.294	135	173.082	161	155.126
6	712.836	32	389.843	58	285.145	84	230.536	110	196.204	136	172.295	162	154.526
7	687.226	33	383.983	59	282.435	85	228.934	111	195.130	137	171.516	163	153.931
8	663.789	34	378.338	60	279.788	86	227.360	112	194.070	138	170.746	164	153.343
9	642.245	35	372.894	61	277.202	87	225.812	113	193.024	139	169.985	165	152.759
10	622.360	36	367.642	62	274.675	88	224.290	114	191.992	140	169.232	166	152.182
11	603.940	37	362.569	63	272.204	89	222.793	115	190.974	141	168.487	167	151.610
12	586.819	38	357.668	64	269.788	90	221.321	116	189.969	142	167.751	168	151.043
13	570.857	39	352.927	65	267.424	91	219.873	117	188.977	143	167.022	169	150.481
14	555.934	40	348.341	66	265.112	92	218.449	118	187.998	144	166.301	170	149.924
15	541.944	41	343.899	67	262.848	93	217.047	119	187.031	145	165.588	171	149.373
16	528.799	42	339.596	68	260.632	94	215.667	120	186.077	146	164.882	172	148.827
17	516.420	43	335.425	69	258.462	95	214.309	121	185.135	147	164.184	173	148.285
18	504.738	44	331.378	70	256.336	96	212.972	122	184.204	148	163.493	174	147.749
19	493.691	45	327.451	71	254.253	97	211.655	123	183.286	149	162.810	175	147.217
20	483.227	46	323.638	72	252.212	98	210.358	124	182.378	150	162.133	176	146.690
21	473.299	47	319.933	73	250.211	99	209.082	125	181.481	151	161.464	177	146.167
22	463.862	48	316.333	74	248.250	100	207.824	126	180.596	152	160.801	178	145.650
23	454.881	49	312.831	75	246.326	101	206.585	127	179.721	153	160.145	179	145.136
24	446.319	50	309.424	76	244.438	102	205.364	128	178.856	154	159.495	180	144.628
25	438.148	51	306.108	77	242.587	103	204.161	129	178.002	155	158.852	181	144.123
26	430.340	52	302.879	78	240.769	104	202.975	130	177.158	156	158.216	182	143.623

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	920.185	27	433.895	53	308.038	79	246.103	105	208.201	131	182.209	157	163.081
2	873.744	28	426.561	54	304.912	80	244.318	106	207.026	132	181.367	158	162.444
3	832.776	29	419.532	55	301.863	81	242.565	107	205.867	133	180.536	159	161.813
4	796.318	30	412.786	56	298.891	82	240.843	108	204.725	134	179.713	160	161.188
5	763.622	31	406.307	57	295.991	83	239.152	109	203.599	135	178.901	161	160.569
6	734.103	32	400.077	58	293.160	84	237.490	110	202.488	136	178.097	162	159.956
7	707.294	33	394.082	59	290.397	85	235.857	111	201.392	137	177.302	163	159.349
8	682.818	34	388.308	60	287.698	86	234.252	112	200.311	138	176.517	164	158.748
9	660.364	35	382.742	61	285.061	87	232.674	113	199.245	139	175.740	165	158.152
10	639.678	36	377.372	62	282.484	88	231.123	114	198.192	140	174.971	166	157.562
11	620.548	37	372.188	63	279.965	89	229.597	115	197.154	141	174.211	167	156.978
12	602.793	38	367.179	64	277.502	90	228.097	116	196.129	142	173.459	168	156.398
13	586.262	39	362.336	65	275.092	91	226.621	117	195.117	143	172.715	169	155.825
14	570.825	40	357.650	66	272.735	92	225.168	118	194.118	144	171.980	170	155.256
15	556.371	41	353.114	67	270.427	93	223.739	119	193.133	145	171.252	171	154.693
16	542.803	42	348.719	68	268.168	94	222.332	120	192.159	146	170.531	172	154.135
17	530.037	43	344.460	69	265.956	95	220.948	121	191.198	147	169.819	173	153.581
18	517.999	44	340.329	70	263.789	96	219.584	122	190.249	148	169.113	174	153.033
19	506.626	45	336.320	71	261.666	97	218.242	123	189.311	149	168.415	175	152.490
20	495.860	46	332.428	72	259.585	98	216.920	124	188.385	150	167.725	176	151.951
21	485.652	47	328.647	73	257.546	99	215.619	125	187.471	151	167.041	177	151.417
22	475.956	48	324.973	74	255.546	100	214.336	126	186.567	152	166.364	178	150.888
23	466.732	49	321.400	75	253.585	101	213.073	127	185.675	153	165.694	179	150.364
24	457.944	50	317.924	76	251.661	102	211.828	128	184.793	154	165.031	180	149.844
25	449.561	51	314.541	77	249.773	103	210.601	129	183.921	155	164.375	181	149.329
26	441.553	52	311.247	78	247.921	104	209.392	130	183.060	156	163.725	182	148.818

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	945.404	27	442.732	53	314.743	79	251.871	105	213.395	131	186.997	157	167.558
2	896.611	28	435.261	54	311.568	80	250.059	106	212.202	132	186.142	158	166.910
3	853.732	29	428.101	55	308.473	81	248.280	107	211.026	133	185.297	159	166.269
4	815.694	30	421.232	56	305.455	82	246.532	108	209.866	134	184.462	160	165.633
5	781.676	31	414.636	57	302.511	83	244.816	109	208.722	135	183.636	161	165.004
6	751.037	32	408.295	58	299.637	84	243.129	110	207.594	136	182.819	162	164.381
7	723.269	33	402.195	59	296.832	85	241.471	111	206.481	137	182.012	163	163.764
8	697.962	34	396.320	60	294.092	86	239.842	112	205.384	138	181.213	164	163.152
9	674.785	35	390.657	61	291.415	87	238.241	113	204.300	139	180.424	165	162.547
10	653.464	36	385.196	62	288.799	88	236.666	114	203.232	140	179.643	166	161.947
11	633.770	37	379.924	63	286.242	89	235.117	115	202.177	141	178.870	167	161.352
12	615.514	38	374.830	64	283.742	90	233.594	116	201.136	142	178.106	168	160.763
13	598.535	39	369.907	65	281.296	91	232.095	117	200.109	143	177.351	169	160.180
14	582.694	40	365.144	66	278.902	92	230.621	118	199.094	144	176.603	170	159.602
15	567.874	41	360.533	67	276.560	93	229.170	119	198.093	145	175.863	171	159.029
16	553.973	42	356.067	68	274.267	94	227.742	120	197.104	146	175.131	172	158.461
17	540.903	43	351.739	69	272.022	95	226.336	121	196.128	147	174.407	173	157.899
18	528.587	44	347.541	70	269.822	96	224.952	122	195.164	148	173.690	174	157.341
19	516.958	45	343.469	71	267.667	97	223.590	123	194.212	149	172.980	175	156.788
20	505.955	46	339.515	72	265.555	98	222.248	124	193.271	150	172.278	176	156.241
21	495.528	47	335.674	73	263.485	99	220.926	125	192.342	151	171.583	177	155.698
22	485.628	48	331.941	74	261.455	100	219.624	126	191.424	152	170.895	178	155.160
23	476.214	49	328.312	75	259.465	101	218.342	127	190.518	153	170.215	179	154.626
24	467.250	50	324.782	76	257.512	102	217.078	128	189.622	154	169.540	180	154.097
25	458.701	51	321.346	77	255.596	103	215.832	129	188.736	155	168.873	181	153.573
26	450.538	52	318.001	78	253.716	104	214.605	130	187.861	156	168.212	182	153.053

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	965.933	27	449.649	53	319.992	79	256.397	105	217.480	131	190.771	157	171.093
2	915.126	28	442.069	54	316.780	80	254.565	106	216.274	132	189.905	158	170.437
3	870.621	29	434.806	55	313.649	81	252.765	107	215.084	133	189.050	159	169.788
4	831.250	30	427.840	56	310.595	82	250.998	108	213.911	134	188.205	160	169.144
5	796.122	31	421.151	57	307.617	83	249.262	109	212.754	135	187.369	161	168.507
6	764.547	32	414.723	58	304.710	84	247.556	110	211.612	136	186.543	162	167.876
7	735.980	33	408.540	59	301.872	85	245.879	111	210.487	137	185.725	163	167.251
8	709.987	34	402.586	60	299.100	86	244.232	112	209.376	138	184.917	164	166.632
9	686.213	35	396.848	61	296.393	87	242.612	113	208.280	139	184.118	165	166.019
10	664.370	36	391.315	62	293.747	88	241.019	114	207.199	140	183.328	166	165.411
11	644.216	37	385.974	63	291.160	89	239.453	115	206.132	141	182.546	167	164.809
12	625.551	38	380.815	64	288.631	90	237.912	116	205.079	142	181.772	168	164.213
13	608.206	39	375.829	65	286.157	91	236.396	117	204.039	143	181.007	169	163.622
14	592.037	40	371.005	66	283.737	92	234.905	118	203.013	144	180.250	170	163.036
15	576.921	41	366.337	67	281.368	93	233.438	119	202.000	145	179.501	171	162.456
16	562.752	42	361.815	68	279.048	94	231.993	120	200.999	146	178.760	172	161.881
17	549.437	43	357.433	69	276.777	95	230.571	121	200.011	147	178.027	173	161.311
18	536.898	44	353.184	70	274.553	96	229.172	122	199.036	148	177.301	174	160.746
19	525.063	45	349.061	71	272.373	97	227.793	123	198.072	149	176.583	175	160.186
20	513.871	46	345.059	72	270.237	98	226.436	124	197.121	150	175.872	176	159.632
21	503.269	47	341.172	73	268.144	99	225.099	125	196.180	151	175.169	177	159.082
22	493.207	48	337.395	74	266.091	100	223.782	126	195.252	152	174.472	178	158.537
23	483.642	49	333.722	75	264.077	101	222.485	127	194.334	153	173.783	179	157.996
24	474.537	50	330.150	76	262.103	102	221.206	128	193.427	154	173.100	180	157.460
25	465.857	51	326.673	77	260.165	103	219.946	129	192.531	155	172.425	181	156.929
26	457.570	52	323.289	78	258.264	104	218.704	130	191.646	156	171.756	182	156.403

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	983.495	27	455.465	53	324.420	79	260.226	105	220.943	131	193.974	157	174.098
2	930.912	28	447.793	54	321.177	80	258.376	106	219.725	132	193.100	158	173.435
3	884.981	29	440.445	55	318.016	81	256.560	107	218.524	133	192.237	159	172.779
4	844.446	30	433.397	56	314.933	82	254.776	108	217.339	134	191.383	160	172.129
5	808.354	31	426.632	57	311.926	83	253.024	109	216.171	135	190.539	161	171.485
6	775.969	32	420.131	58	308.991	84	251.302	110	215.019	136	189.704	162	170.847
7	746.715	33	413.879	59	306.126	85	249.610	111	213.882	137	188.879	163	170.216
8	720.132	34	407.859	60	303.328	86	247.947	112	212.761	138	188.063	164	169.590
9	695.847	35	402.059	61	300.595	87	246.312	113	211.655	139	187.255	165	168.970
10	673.557	36	396.466	62	297.925	88	244.704	114	210.563	140	186.457	166	168.356
11	653.010	37	391.068	63	295.314	89	243.123	115	209.486	141	185.667	167	167.748
12	633.998	38	385.854	64	292.761	90	241.568	116	208.422	142	184.886	168	167.145
13	616.343	39	380.815	65	290.264	91	240.038	117	207.373	143	184.113	169	166.548
14	599.896	40	375.942	66	287.820	92	238.533	118	206.336	144	183.348	170	165.956
15	584.529	41	371.225	67	285.429	93	237.051	119	205.313	145	182.592	171	165.370
16	570.132	42	366.657	68	283.088	94	235.593	120	204.303	146	181.843	172	164.789
17	556.612	43	362.230	69	280.796	95	234.158	121	203.306	147	181.103	173	164.213
18	543.883	44	357.938	70	278.551	96	232.745	122	202.321	148	180.370	174	163.642
19	531.876	45	353.774	71	276.351	97	231.354	123	201.348	149	179.644	175	163.077
20	520.525	46	349.732	72	274.195	98	229.984	124	200.387	150	178.926	176	162.516
21	509.776	47	345.806	73	272.082	99	228.634	125	199.437	151	178.215	177	161.960
22	499.577	48	341.992	74	270.010	100	227.305	126	198.499	152	177.512	178	161.409
23	489.886	49	338.283	75	267.978	101	225.995	127	197.573	153	176.815	179	160.863
24	480.663	50	334.676	76	265.984	102	224.704	128	196.657	154	176.126	180	160.322
25	471.873	51	331.166	77	264.029	103	223.432	129	195.752	155	175.443	181	159.785
26	463.483	52	327.748	78	262.109	104	222.179	130	194.858	156	174.767	182	159.252

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	998.830	27	460.436	53	328.212	79	263.512	105	223.921	131	196.733	157	176.688
2	944.646	28	452.687	54	324.943	80	261.648	106	222.693	132	195.852	158	176.020
3	897.439	29	445.265	55	321.756	81	259.818	107	221.482	133	194.981	159	175.358
4	855.867	30	438.149	56	318.649	82	258.020	108	220.288	134	194.120	160	174.702
5	818.918	31	431.318	57	315.618	83	256.254	109	219.111	135	193.269	161	174.053
6	785.818	32	424.755	58	312.660	84	254.519	110	217.949	136	192.427	162	173.410
7	755.958	33	418.444	59	309.772	85	252.813	111	216.803	137	191.595	163	172.772
8	728.855	34	412.368	60	306.952	86	251.137	112	215.673	138	190.772	164	172.141
9	704.123	35	406.515	61	304.197	87	249.489	113	214.558	139	189.958	165	171.516
10	681.442	36	400.871	62	301.506	88	247.869	114	213.457	140	189.153	166	170.897
11	660.553	37	395.424	63	298.874	89	246.276	115	212.371	141	188.356	167	170.283
12	641.238	38	390.164	64	296.301	90	244.708	116	211.299	142	187.569	168	169.675
13	623.313	39	385.081	65	293.784	91	243.166	117	210.241	143	186.789	169	169.073
14	606.625	40	380.165	66	291.322	92	241.649	118	209.197	144	186.018	170	168.476
15	591.041	41	375.407	67	288.912	93	240.156	119	208.165	145	185.255	171	167.884
16	576.448	42	370.800	68	286.553	94	238.687	120	207.147	146	184.500	172	167.298
17	562.749	43	366.335	69	284.243	95	237.241	121	206.141	147	183.753	173	166.717
18	549.858	44	362.007	70	281.980	96	235.816	122	205.148	148	183.014	174	166.141
19	537.702	45	357.808	71	279.763	97	234.414	123	204.167	149	182.282	175	165.570
20	526.214	46	353.732	72	277.590	98	233.033	124	203.198	150	181.558	176	165.005
21	515.339	47	349.774	73	275.460	99	231.673	125	202.241	151	180.841	177	164.444
22	505.023	48	345.927	74	273.372	100	230.333	126	201.296	152	180.132	178	163.888
23	495.224	49	342.188	75	271.324	101	229.013	127	200.361	153	179.429	179	163.337
24	485.900	50	338.551	76	269.316	102	227.712	128	199.438	154	178.734	180	162.791
25	477.015	51	335.013	77	267.345	103	226.430	129	198.526	155	178.045	181	162.249
26	468.537	52	331.567	78	265.410	104	225.166	130	197.624	156	177.363	182	161.712



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	1012.468	27	464.773	53	331.526	79	266.390	105	226.533	131	199.156	157	178.966
2	956.822	28	456.956	54	328.235	80	264.513	106	225.296	132	198.269	158	178.292
3	908.454	29	449.471	55	325.026	81	262.671	107	224.077	133	197.392	159	177.626
4	865.942	30	442.294	56	321.897	82	260.861	108	222.875	134	196.525	160	176.965
5	828.221	31	435.406	57	318.846	83	259.083	109	221.690	135	195.667	161	176.311
6	794.476	32	428.790	58	315.867	84	257.336	110	220.520	136	194.820	162	175.663
7	764.073	33	422.427	59	312.960	85	255.620	111	219.367	137	193.981	163	175.021
8	736.507	34	416.303	60	310.121	86	253.932	112	218.228	138	193.152	164	174.385
9	711.374	35	410.403	61	307.348	87	252.274	113	217.106	139	192.333	165	173.755
10	688.347	36	404.715	62	304.638	88	250.643	114	215.997	140	191.522	166	173.131
11	667.153	37	399.226	63	301.988	89	249.038	115	214.904	141	190.719	167	172.513
12	647.569	38	393.926	64	299.398	90	247.461	116	213.824	142	189.926	168	171.900
13	629.406	39	388.805	65	296.864	91	245.908	117	212.759	143	189.141	169	171.293
14	612.504	40	383.851	66	294.386	92	244.381	118	211.707	144	188.364	170	170.692
15	596.729	41	379.058	67	291.959	93	242.878	119	210.669	145	187.596	171	170.096
16	581.964	42	374.417	68	289.584	94	241.399	120	209.643	146	186.835	172	169.505
17	568.108	43	369.920	69	287.259	95	239.943	121	208.630	147	186.083	173	168.920
18	555.074	44	365.560	70	284.981	96	238.509	122	207.630	148	185.338	174	168.339
19	542.787	45	361.331	71	282.749	97	237.097	123	206.643	149	184.601	175	167.764
20	531.179	46	357.226	72	280.562	98	235.707	124	205.667	150	183.872	176	167.194
21	520.192	47	353.239	73	278.418	99	234.337	125	204.703	151	183.149	177	166.629
22	509.775	48	349.365	74	276.316	100	232.988	126	203.751	152	182.435	178	166.069
23	499.881	49	345.600	75	274.254	101	231.659	127	202.810	153	181.727	179	165.514
24	490.468	50	341.938	76	272.232	102	230.350	128	201.880	154	181.026	180	164.963
25	481.501	51	338.374	77	270.248	103	229.059	129	200.961	155	180.333	181	164.417
26	472.946	52	334.905	78	268.301	104	227.787	130	200.053	156	179.646	182	163.876

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	1025.738	27	469.285	53	335.016	79	269.426	105	229.288	131	201.710	157	181.365
2	968.719	28	461.401	54	331.701	80	267.536	106	228.042	132	200.816	158	180.686
3	919.263	29	453.853	55	328.470	81	265.681	107	226.815	133	199.932	159	180.014
4	875.872	30	446.617	56	325.319	82	263.859	108	225.604	134	199.059	160	179.348
5	837.428	31	439.673	57	322.246	83	262.068	109	224.410	135	198.195	161	178.689
6	803.081	32	433.003	58	319.247	84	260.309	110	223.232	136	197.341	162	178.035
7	772.168	33	426.590	59	316.319	85	258.581	111	222.070	137	196.496	163	177.388
8	744.167	34	420.418	60	313.460	86	256.882	112	220.923	138	195.661	164	176.748
9	718.660	35	414.472	61	310.668	87	255.211	113	219.792	139	194.835	165	176.113
10	695.306	36	408.740	62	307.939	88	253.569	114	218.676	140	194.018	166	175.484
11	673.825	37	403.209	63	305.271	89	251.953	115	217.574	141	193.209	167	174.860
12	653.988	38	397.869	64	302.663	90	250.364	116	216.487	142	192.410	168	174.243
13	635.600	39	392.709	65	300.112	91	248.801	117	215.414	143	191.619	169	173.631
14	618.496	40	387.719	66	297.616	92	247.263	118	214.354	144	190.836	170	173.025
15	602.539	41	382.890	67	295.173	93	245.750	119	213.308	145	190.062	171	172.424
16	587.609	42	378.215	68	292.781	94	244.260	120	212.275	146	189.295	172	171.828
17	573.604	43	373.685	69	290.440	95	242.793	121	211.255	147	188.537	173	171.238
18	560.434	44	369.293	70	288.146	96	241.350	122	210.248	148	187.787	174	170.653
19	548.021	45	365.033	71	285.898	97	239.928	123	209.252	149	187.044	175	170.074
20	536.298	46	360.898	72	283.696	98	238.528	124	208.270	150	186.309	176	169.499
21	525.205	47	356.882	73	281.537	99	237.148	125	207.299	151	185.581	177	168.929
22	514.689	48	352.981	74	279.421	100	235.790	126	206.339	152	184.861	178	168.365
23	504.703	49	349.189	75	277.345	101	234.451	127	205.391	153	184.147	179	167.805
24	495.205	50	345.500	76	275.309	102	233.132	128	204.455	154	183.441	180	167.250
25	486.158	51	341.912	77	273.311	103	231.832	129	203.529	155	182.742	181	166.699
26	477.528	52	338.418	78	271.350	104	230.551	130	202.614	156	182.050	182	166.154