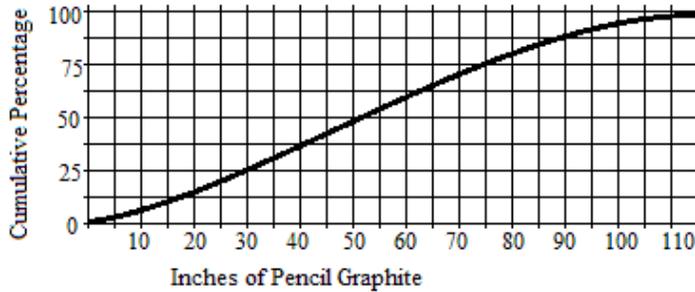


Remember to give exact answers unless otherwise specified.

1. The cumulative frequency plot for the inches of pencil graphite used by competitors at the National Mu Alpha Theta Convention is shown below:



What is the interquartile range for this graph?

- A. 45      B. 50      C. 60      D. 400      E. NOTA
2. In an ordinary bag of skittles, 20% are expected to be green, 30% yellow, 15% red, 15% purple, and 20% orange. Consider a bag of skittles with the following distribution:
- | Color  | Green | Yellow | Red | Purple | Orange |
|--------|-------|--------|-----|--------|--------|
| Amount | 13    | 8      | 6   | 12     | 11     |
- Calculate the chi-squared test statistic.
- A. 4      B. 7.26      C. 8.97      D. 20525/2288      E. NOTA
3. Maya has three cards. One card is black on one side and blue on the other, another card is blue on both sides, and the third card is black on both sides. If Maya randomly selects a card and the face she sees is blue, what is the probability the other face is blue?
- A. 1/6      B. 1/3      C. 1/2      D. 2/3      E. NOTA
4. Ashley throws a Frisbee with hopes that it will be catchable for Hanisha. She does this with a 27% failure rate and stops once she has thrown a catchable Frisbee. Today Ashley made 6 attempts before a successful Frisbee was thrown. What is the expected value of trials needed in order for a catchable Frisbee to be thrown?
- A. 100/73      B. 81/50      C. 100/27      D. 219/50
5. Donovan is successful in making 20% of the goals he attempts. He decides to construct a simulation to estimate the mean number of attempts he needs to make before scoring a goal. Which of the following schemes could he use to do the simulation?
- A. Assign numbers “0,1” to successfully making a goal and “2,3,4,5,6,7,8,9” to failing to make a goal.  
 B. Assign numbers “0,1” to successfully making a goal and “2,3,4” to failing to make a goal.  
 C. Assign number “0” to successfully making a goal and “1” to failing to make a goal.  
 D. Assign numbers “0,1,2,3,4” to successfully making a goal and “5,6,7,8,9” to failing to make a goal.  
 E. NOTA
6. The power for a hypothesis test run at a 5% significance level was .78. Find the sum of the probability of a Type I error and the probability of a Type II error.
- A. .05      B. .27      C. .83      D. 1      E. NOTA



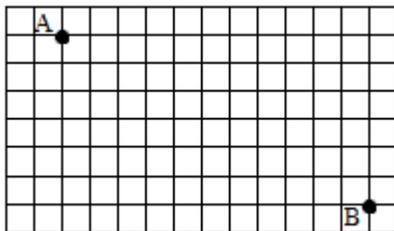
14. There are 50 students at Stars Hollow High. Of these students, 29 take Literature, 31 take History, 25 take Art, and 28 take Music. 16 students take both Literature and History, 10 take Art and Literature, 22 take Art and History, 11 take Music and Art, 19 take Music and Literature, and 14 take Music and History. 5 Students take all 4 classes. If all students take at least one class and no students take Literature and Art only or History and Music only, how many students take exactly 3 of these 4 classes?  
A. 14                      B. 19                      C. 20                      D. 39                      E. NOTA

15. A system consists of components that each work correctly with probability  $p$ . The components work independently of each other, and the system will be able to operate if and only if at least one-half of its components are working. A system with five components is more likely to operate than a system with three components if  $p$  is on the interval  $(x,1)$ . Find the least possible value of  $x$ .  
A.  $-1/2$                       B. 0                      C.  $1/2$                       D. 1                      E. NOTA

16. Consider  $f(x) = \sqrt{x(2k-x)}$ . Which of the following values of  $k$  makes  $f(x)$  a probability density function?  
A.  $\frac{\sqrt{2\pi}}{\pi}$                       B.  $\frac{\sqrt{\pi}}{\pi}$                       C.  $\frac{\sqrt{\pi}}{2\pi}$                       D.  $2\frac{\sqrt{\pi}}{\pi}$                       E. NOTA

17. For a one-sample z-interval, the mean is 30, the standard deviation is 8, and the sample size is 100. If the interval is from 28.432 to 31.568, what is the confidence level used? Round to three decimal places.  
A. .900                      B. .950                      C. .975                      D. .990                      E. NOTA

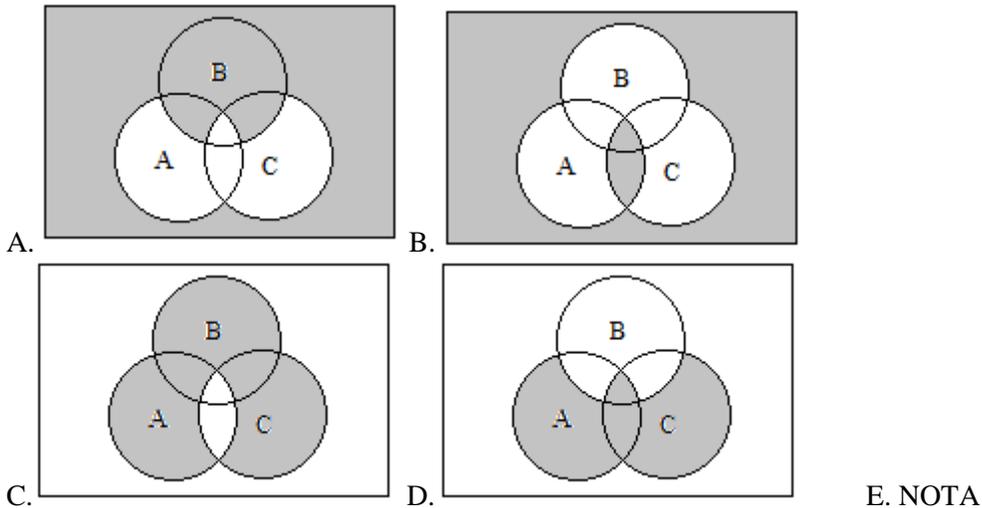
18. How many distinct paths are possible from point A to point B, given that you can only move on the grid down or to the right, one step at a time?



- A. 462                      B. 12376                      C. 8910720                      D. 18564                      E. NOTA
19. Vishal is learning how to tie his shoes. He ties them correctly  $1/4$  of the time. If the probability of exactly  $n$  successes and  $m$  failures is  $1215/4096$ , and  $m+n = 6$ , find  $m$ .  
A. 2                      B. 3                      C. 4                      D. 5                      E. NOTA
20. Daniel's mom thinks he plays the drums an average of 67 minutes a day with a population standard deviation of 5 minutes. Daniel thinks this is an incorrect assumption. He records the amount of time he practices for two weeks and arrives at a mean of  $n$ , which is a natural number. In order for the data to be significant at the 10% alpha level,  $n$  must lie on the interval  $(0, a] \cup [b, \infty)$  where  $a$  and  $b$  are integers. Find  $|a-b|$ .  
A. 3                      B. 4                      C. 5                      D. 6                      E. NOTA

21. In the set of the first 10 digits of pi, which are outliers?  
 A. 1 only      B. 1, 2, and 9      C. 1 and 9 only      D. 9 only      E. NOTA
22. Ignoring many real world factors, we model projectile motion as  $x = x_o + v_o t + \frac{1}{2}at^2$ , where  $x$  is the final position,  $x_o$  is the initial position,  $v_o$  is initial velocity,  $a$  is acceleration ( $-9.8 \text{ m/s}^2$ ), and  $t$  is time. On a windy day, Sydney kicks a soccer ball with an initial velocity of 7 m/s and it travels 10 meters, leading to a residual of 7.5 meters. What is the “expected” time in the air?  
 A.  $5/7$  s      B. .7841 s      C.  $\frac{5 + 5\sqrt{2}}{7}$  s      D. Not enough info  
 E. NOTA

23. Which of the following correctly demonstrates  $((A \cup C) \cap B') \cup (A \cap C)$  ?



24. A Normal approximation of a Binomial distribution is given by

$$z \text{ score for } P(X \leq x) = \frac{x + .5 - np}{\sqrt{npq}}$$

$$z \text{ score for } P(X \leq x) = \frac{x + .5 - np}{\sqrt{npq}}$$

Using a Normal approximation to a Binomial distribution, find the probability that the experiment that consists of 50 tosses of a fair coin results in exactly 25 heads. (Use a table).

- A. 0      B. .1114      C. .5      D. .5557      E. NOTA
25. The probability of drawing an integer  $x$  on the closed interval  $[1,4]$  is  $\frac{x-1}{6}$ . What is the expected value?  
 A. 0      B. 3.33      C.  $10/3$       D.  $13/3$       E. NOTA
26. Marshall wants to know how well he did on his physics test compared to the other students in his class, but his teacher won't tell him. After much begging, his teacher reveals that the standard deviation of the approximately normal distribution of the test scores of the class is 12 points. Marshall scored a 95 on the test and will only be happy if he's in the 99<sup>th</sup> percentile, and Pratik scored an 89 on the test. If Pratik, who is more in

with the teacher, knows he is in the 90<sup>th</sup> percentile, what is the mean score in the class, and is Marshall happy? Round answers to two decimal places.

- A. 96.26, yes                      B. 96.26, no  
 C. 73.64, yes                      D. 73.64, no                      E. NOTA

27. Given the following discrete distribution find  $E[x^2]$

x	5	6	3	8	7
P(x)	.1	.15	.4	.2	.15

- A. .958625      B. 5.25              C. 27.5625      D. 31.65              E. NOTA

28. Consider the following sets:

- $A = \{2, 3, 5, 7, \dots, 23\}$   
 $B = \{1, 3, 6, 10, \dots, 45\}$

Given that the sets are independent, find  $\sigma_{A+B}^2$

- A. 259.654      B. 59024.85      C. 292111/1125              D. 2629/9              E. NOTA

29. A t-distribution with degrees of freedom of 5 is \_\_\_\_\_ in the tails than a standard normal curve?

- A. wider                              B. narrower      C. more to the left only  
 D. more to the right only      E. NOTA

30. Ashley is getting a sundae at Kilwin's. There are 15 flavors of ice cream, three sauces (chocolate, caramel, and raspberry), two kinds of whipped cream (chocolate and vanilla), and eight different toppings (M&Ms, Oreos, gummy bears, rainbow sprinkles, chocolate sprinkles, chocolate chips, peanuts, and walnuts). All sundaes have exactly one flavor of ice cream, one sauce, one whipped cream flavor and two distinct toppings. Ashley is allergic to peanuts and her favorite ice cream flavor at Kilwin's is cookie dough. If all factors are random and have an equal likelihood of occurring, what is the probability she will get a sundae with her favorite flavor that she is not allergic to?

- A. 2/45              B. 1/20              C. 24/361              D. 3/4              E. NOTA

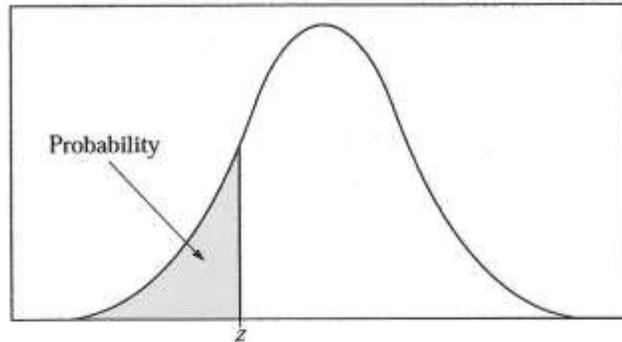


Table entry for  $z$  is the probability lying below  $z$ .

**Table A** Standard normal probabilities

$z$	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
-3.4	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0002
-3.3	.0005	.0005	.0005	.0004	.0004	.0004	.0004	.0004	.0004	.0003
-3.2	.0007	.0007	.0006	.0006	.0006	.0006	.0006	.0005	.0005	.0005
-3.1	.0010	.0009	.0009	.0009	.0008	.0008	.0008	.0008	.0007	.0007
-3.0	.0013	.0013	.0013	.0012	.0012	.0011	.0011	.0011	.0010	.0010
-2.9	.0019	.0018	.0018	.0017	.0016	.0016	.0015	.0015	.0014	.0014
-2.8	.0026	.0025	.0024	.0023	.0023	.0022	.0022	.0021	.0020	.0019
-2.7	.0035	.0034	.0033	.0032	.0031	.0030	.0029	.0028	.0027	.0026
-2.6	.0047	.0045	.0044	.0043	.0041	.0040	.0039	.0038	.0037	.0036
-2.5	.0062	.0060	.0059	.0057	.0055	.0054	.0052	.0051	.0049	.0048
-2.4	.0082	.0080	.0078	.0075	.0073	.0071	.0069	.0068	.0066	.0064
-2.3	.0107	.0104	.0102	.0099	.0096	.0094	.0091	.0089	.0087	.0084
-2.2	.0139	.0136	.0132	.0129	.0125	.0122	.0119	.0116	.0113	.0110
-2.1	.0179	.0174	.0170	.0166	.0162	.0158	.0154	.0150	.0146	.0143
-2.0	.0228	.0222	.0217	.0212	.0207	.0202	.0197	.0192	.0188	.0183
-1.9	.0287	.0281	.0274	.0268	.0262	.0256	.0250	.0244	.0239	.0233
-1.8	.0359	.0351	.0344	.0336	.0329	.0322	.0314	.0307	.0301	.0294
-1.7	.0446	.0436	.0427	.0418	.0409	.0401	.0392	.0384	.0375	.0367
-1.6	.0548	.0537	.0526	.0516	.0505	.0495	.0485	.0475	.0465	.0455
-1.5	.0668	.0655	.0643	.0630	.0618	.0606	.0594	.0582	.0571	.0559
-1.4	.0808	.0793	.0778	.0764	.0749	.0735	.0721	.0708	.0694	.0681
-1.3	.0968	.0951	.0934	.0918	.0901	.0885	.0869	.0853	.0838	.0823
-1.2	.1151	.1131	.1112	.1093	.1075	.1056	.1038	.1020	.1003	.0985
-1.1	.1357	.1335	.1314	.1292	.1271	.1251	.1230	.1210	.1190	.1170
-1.0	.1587	.1562	.1539	.1515	.1492	.1469	.1446	.1423	.1401	.1379
-0.9	.1841	.1814	.1788	.1762	.1736	.1711	.1685	.1660	.1635	.1611
-0.8	.2119	.2090	.2061	.2033	.2005	.1977	.1949	.1922	.1894	.1867
-0.7	.2420	.2389	.2358	.2327	.2296	.2266	.2236	.2206	.2177	.2148
-0.6	.2743	.2709	.2676	.2643	.2611	.2578	.2546	.2514	.2483	.2451
-0.5	.3085	.3050	.3015	.2981	.2946	.2912	.2877	.2843	.2810	.2776
-0.4	.3446	.3409	.3372	.3336	.3300	.3264	.3228	.3192	.3156	.3121
-0.3	.3821	.3783	.3745	.3707	.3669	.3632	.3594	.3557	.3520	.3483
-0.2	.4207	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
-0.1	.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247
-0.0	.5000	.4960	.4920	.4880	.4840	.4801	.4761	.4721	.4681	.4641



Table entry for  $p$  and  $C$  is the point  $t^*$  with probability  $p$  lying above it and probability  $C$  lying between  $-t^*$  and  $t^*$ .

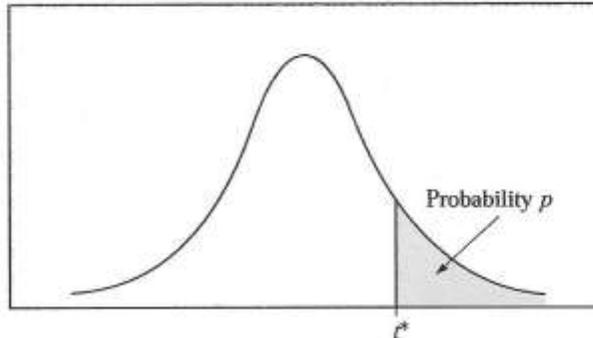


Table B  $t$  distribution critical values

df	Tail probability $p$											
	.25	.20	.15	.10	.05	.025	.02	.01	.005	.0025	.001	.0005
1	1.000	1.376	1.963	3.078	6.314	12.71	15.89	31.82	63.66	127.3	318.3	636.6
2	.816	1.061	1.386	1.886	2.920	4.303	4.849	6.965	9.925	14.09	22.33	31.60
3	.765	.978	1.250	1.638	2.353	3.182	3.482	4.541	5.841	7.453	10.21	12.92
4	.741	.941	1.190	1.533	2.132	2.776	2.999	3.747	4.604	5.598	7.173	8.610
5	.727	.920	1.156	1.476	2.015	2.571	2.757	3.365	4.032	4.773	5.893	6.869
6	.718	.906	1.134	1.440	1.943	2.447	2.612	3.143	3.707	4.317	5.208	5.959
7	.711	.896	1.119	1.415	1.895	2.365	2.517	2.998	3.499	4.029	4.785	5.408
8	.706	.889	1.108	1.397	1.860	2.306	2.449	2.896	3.355	3.833	4.501	5.041
9	.703	.883	1.100	1.383	1.833	2.262	2.398	2.821	3.250	3.690	4.297	4.781
10	.700	.879	1.093	1.372	1.812	2.228	2.359	2.764	3.169	3.581	4.144	4.587
11	.697	.876	1.088	1.363	1.796	2.201	2.328	2.718	3.106	3.497	4.025	4.437
12	.695	.873	1.083	1.356	1.782	2.179	2.303	2.681	3.055	3.428	3.930	4.318
13	.694	.870	1.079	1.350	1.771	2.160	2.282	2.650	3.012	3.372	3.852	4.221
14	.692	.868	1.076	1.345	1.761	2.145	2.264	2.624	2.977	3.326	3.787	4.140
15	.691	.866	1.074	1.341	1.753	2.131	2.249	2.602	2.947	3.286	3.733	4.073
16	.690	.865	1.071	1.337	1.746	2.120	2.235	2.583	2.921	3.252	3.686	4.015
17	.689	.863	1.069	1.333	1.740	2.110	2.224	2.567	2.898	3.222	3.646	3.965
18	.688	.862	1.067	1.330	1.734	2.101	2.214	2.552	2.878	3.197	3.611	3.922
19	.688	.861	1.066	1.328	1.729	2.093	2.205	2.539	2.861	3.174	3.579	3.883
20	.687	.860	1.064	1.325	1.725	2.086	2.197	2.528	2.845	3.153	3.552	3.850
21	.686	.859	1.063	1.323	1.721	2.080	2.189	2.518	2.831	3.135	3.527	3.819
22	.686	.858	1.061	1.321	1.717	2.074	2.183	2.508	2.819	3.119	3.505	3.792
23	.685	.858	1.060	1.319	1.714	2.069	2.177	2.500	2.807	3.104	3.485	3.768
24	.685	.857	1.059	1.318	1.711	2.064	2.172	2.492	2.797	3.091	3.467	3.745
25	.684	.856	1.058	1.316	1.708	2.060	2.167	2.485	2.787	3.078	3.450	3.725
26	.684	.856	1.058	1.315	1.706	2.056	2.162	2.479	2.779	3.067	3.435	3.707
27	.684	.855	1.057	1.314	1.703	2.052	2.158	2.473	2.771	3.057	3.421	3.690
28	.683	.855	1.056	1.313	1.701	2.048	2.154	2.467	2.763	3.047	3.408	3.674
29	.683	.854	1.055	1.311	1.699	2.045	2.150	2.462	2.756	3.038	3.396	3.659
30	.683	.854	1.055	1.310	1.697	2.042	2.147	2.457	2.750	3.030	3.385	3.646
40	.681	.851	1.050	1.303	1.684	2.021	2.123	2.423	2.704	2.971	3.307	3.551
50	.679	.849	1.047	1.299	1.676	2.009	2.109	2.403	2.678	2.937	3.261	3.496
60	.679	.848	1.045	1.296	1.671	2.000	2.099	2.390	2.660	2.915	3.232	3.460
80	.678	.846	1.043	1.292	1.664	1.990	2.088	2.374	2.639	2.887	3.195	3.416
100	.677	.845	1.042	1.290	1.660	1.984	2.081	2.364	2.626	2.871	3.174	3.390
1000	.675	.842	1.037	1.282	1.646	1.962	2.056	2.330	2.581	2.813	3.098	3.300
$\infty$	.674	.841	1.036	1.282	1.645	1.960	2.054	2.326	2.576	2.807	3.091	3.291
	50%	60%	70%	80%	90%	95%	96%	98%	99%	99.5%	99.8%	99.9%
Confidence level $C$												

Table entry for  $p$  is the point  $(\chi^2)$  with probability  $p$  lying above it.

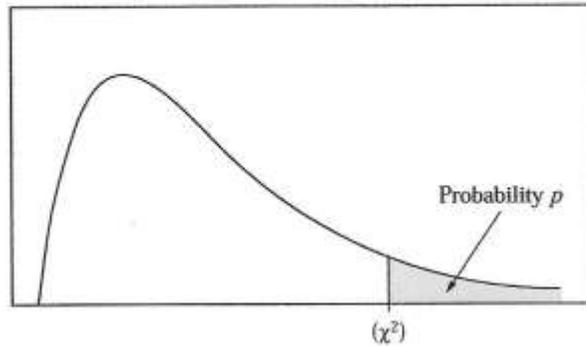


Table C  $\chi^2$  critical values

df	Tail probability $p$											
	.25	.20	.15	.10	.05	.025	.02	.01	.005	.0025	.001	.0005
1	1.32	1.64	2.07	2.71	3.84	5.02	5.41	6.63	7.88	9.14	10.83	12.12
2	2.77	3.22	3.79	4.61	5.99	7.38	7.82	9.21	10.60	11.98	13.82	15.20
3	4.11	4.64	5.32	6.25	7.81	9.35	9.84	11.34	12.84	14.32	16.27	17.73
4	5.39	5.99	6.74	7.78	9.49	11.14	11.67	13.28	14.86	16.42	18.47	20.00
5	6.63	7.29	8.12	9.24	11.07	12.83	13.39	15.09	16.75	18.39	20.51	22.11
6	7.84	8.56	9.45	10.64	12.59	14.45	15.03	16.81	18.55	20.25	22.46	24.10
7	9.04	9.80	10.75	12.02	14.07	16.01	16.62	18.48	20.28	22.04	24.32	26.02
8	10.22	11.03	12.03	13.36	15.51	17.53	18.17	20.09	21.95	23.77	26.12	27.87
9	11.39	12.24	13.29	14.68	16.92	19.02	19.68	21.67	23.59	25.46	27.88	29.67
10	12.55	13.44	14.53	15.99	18.31	20.48	21.16	23.21	25.19	27.11	29.59	31.42
11	13.70	14.63	15.77	17.28	19.68	21.92	22.62	24.72	26.76	28.73	31.26	33.14
12	14.85	15.81	16.99	18.55	21.03	23.34	24.05	26.22	28.30	30.32	32.91	34.82
13	15.98	16.98	18.20	19.81	22.36	24.74	25.47	27.69	29.82	31.88	34.53	36.48
14	17.12	18.15	19.41	21.06	23.68	26.12	26.87	29.14	31.32	33.43	36.12	38.11
15	18.25	19.31	20.60	22.31	25.00	27.49	28.26	30.58	32.80	34.95	37.70	39.72
16	19.37	20.47	21.79	23.54	26.30	28.85	29.63	32.00	34.27	36.46	39.25	41.31
17	20.49	21.61	22.98	24.77	27.59	30.19	31.00	33.41	35.72	37.95	40.79	42.88
18	21.60	22.76	24.16	25.99	28.87	31.53	32.35	34.81	37.16	39.42	42.31	44.43
19	22.72	23.90	25.33	27.20	30.14	32.85	33.69	36.19	38.58	40.88	43.82	45.97
20	23.83	25.04	26.50	28.41	31.41	34.17	35.02	37.57	40.00	42.34	45.31	47.50
21	24.93	26.17	27.66	29.62	32.67	35.48	36.34	38.93	41.40	43.78	46.80	49.01
22	26.04	27.30	28.82	30.81	33.92	36.78	37.66	40.29	42.80	45.20	48.27	50.51
23	27.14	28.43	29.98	32.01	35.17	38.08	38.97	41.64	44.18	46.62	49.73	52.00
24	28.24	29.55	31.13	33.20	36.42	39.36	40.27	42.98	45.56	48.03	51.18	53.48
25	29.34	30.68	32.28	34.38	37.65	40.65	41.57	44.31	46.93	49.44	52.62	54.95
26	30.43	31.79	33.43	35.56	38.89	41.92	42.86	45.64	48.29	50.83	54.05	56.41
27	31.53	32.91	34.57	36.74	40.11	43.19	44.14	46.96	49.64	52.22	55.48	57.86
28	32.62	34.03	35.71	37.92	41.34	44.46	45.42	48.28	50.99	53.59	56.89	59.30
29	33.71	35.14	36.85	39.09	42.56	45.72	46.69	49.59	52.34	54.97	58.30	60.73
30	34.80	36.25	37.99	40.26	43.77	46.98	47.96	50.89	53.67	56.33	59.70	62.16
40	45.62	47.27	49.24	51.81	55.76	59.34	60.44	63.69	66.77	69.70	73.40	76.09
50	56.33	58.16	60.35	63.17	67.50	71.42	72.61	76.15	79.49	82.66	86.66	89.56
60	66.98	68.97	71.34	74.40	79.08	83.30	84.58	88.38	91.95	95.34	99.61	102.7
80	88.13	90.41	93.11	96.58	101.9	106.6	108.1	112.3	116.3	120.1	124.8	128.3
100	109.1	111.7	114.7	118.5	124.3	129.6	131.1	135.8	140.2	144.3	149.4	153.2