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NEW YORK UNIVERSITY

Far Infrared Project

Physics Department, W.S.C.

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SCIENTIFIC REPORT #15

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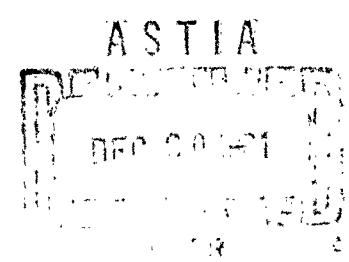
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A Study of the Far Infrared Properties of Crystals

by

J. H. ROHRBAUGH



AIR FORCE CAMBRIDGE RESEARCH LABORATORIES
OFFICE OF AEROSPACE RESEARCH
CONTRACT NO. AF19(604)-2673
MARCH 1, 1961 to MAY 31, 1961

AFCRL 954

**A STUDY OF THE FAR INFRARED
PROPERTIES OF CRYSTALS**

Contract AF19(604)-2673

Scientific Report #15

March 1, 1961 to May 31, 1961

Submitted by

J. H. Rohrbaugh
Project Director

Physics Department Research Project
Washington Square College of Arts
and Science

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Abstract

Tables are presented giving the Coulomb terms for each different wave number for the f. c. c. alkali halide crystal for a subdivision of 2^4 in wave number space. These Coulomb terms are independent of the masses and interionic separation for general use. When the constants appropriate to a particular lattice are used and repulsive terms added, to eigenfrequencies and eigenvectors can be computed from which the optical properties in the far infrared can be obtained.

The Coulomb Coupling Coefficients for Face Centered Ionic Crystals

As is well known, any realistic model for ionic crystals must include the electrostatic interaction of the crystal ions. Thus in order to obtain frequency distribution functions and related values of specific heat by the methods of lattice dynamics, the Coulomb terms must first be calculated for a fairly dense set of wave vectors. Treating the ions as point charges, Kellerman¹ derived a set of series for obtaining these Coulomb terms. These formulae were used by us for obtaining the frequency distribution of NaCl both at room temperature and at 2°K. Face centered ionic crystals require the specification of 12 types of Coulomb terms as follows:

$$\frac{V_a}{e^2} \begin{bmatrix} 1 & 1 \\ x & y \end{bmatrix}^c = H_{xy}^l - G_{xy}^{11} + \frac{8}{3\sqrt{\pi}} \delta_{xy} \quad (1)$$

and

$$\frac{V_a}{e^2} \begin{bmatrix} 1 & 2 \\ x & y \end{bmatrix} = G_{xy}^{12} - H_{xy}^m \quad (2)$$

Where V_a is the cell value and e is the electronic charge.

In both Eq's (1) and (2), x and y can take on all three variables x, y, z , we thus have 6 equations each of type (1) and (2).

G and H are defined by the series:

$$G_{xy}'' = 4\pi \sum_{h_x, h_y, h_z} \frac{(h_x + q_x)(h_y + q_y)}{(\vec{h} + \vec{q})^2} e^{-\frac{\pi^2}{4}(\vec{h} + \vec{q})^2}$$

$$G_{xy}^{12} = 4\pi \sum_{h_x, h_y, h_z} \frac{(h_x + q_x)(h_y + q_y)}{(\vec{h} + \vec{q})^2} e^{-\frac{\pi^2}{4}(\vec{h} + \vec{q})^2} \cos \pi (h_x + h_y + h_z) \quad (3)$$

$$H_{xy}^l = 2 \sum_l \left[g(l) \frac{l_x l_y}{l^2} - f(l) \delta_{xy} \right] \cos \pi \vec{q} \cdot \vec{l} \quad (4)$$

$$H_{xy}^m = 2 \sum_{m_x, m_y, m_z} \left[g(m) \frac{m_x m_y}{m^2} - f(m) \delta_{xy} \right] \cos \pi \vec{q} \cdot \vec{m} \quad (5)$$

with

$$f(l) = \frac{2}{\sqrt{\pi}} \frac{e^{-l^2}}{l^2} + \psi(l) \quad (6)$$

(7)

$$g(l) = \frac{4}{\sqrt{\pi}} e^{-l^2} + \frac{6}{\sqrt{\pi}} \frac{e^{-l^2}}{l^2} + 3 \psi(l)$$

(8)

and

$$\psi(l) = 1 - \frac{2}{\sqrt{\pi}} \int_0^l e^{-\xi^2} d\xi$$

(9)

The components of $\vec{l}$ and $\vec{m}$ are integers (positive or negative) with the restrictions that $l_x + l_y + l_z$ must be even and $m_x + m_y + m_z$ must be odd. The components of h are integers and must be either all odd or all even. The q 's are the rectangular components of the wave vector $\vec{\sigma}$ when written in the form $\vec{\sigma} = \frac{1}{2r_0} (q_x, q_y, q_z)$ where r_0 the interatomic distance. The q 's range from 0 to 1 in steps of the order 10^{-23} . Clearly one can take only a minute sample of these q 's. Kellerman divided the q range into 10 parts yielding some 48 points for which the series were evaluated. We have divided the range of q 's into 24 parts which resulted in 422 allowed q 's. The results tabulated below were obtained with the help of a IBM 704 computer. The components of the q 's are written in integer form and should be divided by 24. Thus the first wave vector is actually $\frac{24}{24}, \frac{12}{24}, 0$.

The Coulomb terms are written in the order

$\frac{V_a}{e^2} \begin{bmatrix} 1 & 1 \\ x & x \end{bmatrix}$	$\frac{V_a}{e^2} \begin{bmatrix} 1 & 1 \\ x & y \end{bmatrix}$	$\frac{V_a}{e^2} \begin{bmatrix} 1 & 1 \\ x & z \end{bmatrix}$	$\frac{V_a}{e^2} \begin{bmatrix} 1 & 1 \\ y & y \end{bmatrix}$
$\frac{V_a}{e^2} \begin{bmatrix} 1 & 1 \\ y & z \end{bmatrix}$	$\frac{V_a}{e^2} \begin{bmatrix} 1 & 1 \\ z & z \end{bmatrix}$	$\frac{V_a}{e^2} \begin{bmatrix} 1 & 2 \\ x & x \end{bmatrix}$	$\frac{V_a}{e^2} \begin{bmatrix} 1 & 2 \\ y & y \end{bmatrix}$
$\frac{V_a}{e^2} \begin{bmatrix} 1 & 2 \\ z & z \end{bmatrix}$	$\frac{V_a}{e^2} \begin{bmatrix} 1 & 2 \\ x & y \end{bmatrix}$	$\frac{V_a}{e^2} \begin{bmatrix} 1 & 2 \\ x & z \end{bmatrix}$	$\frac{V_a}{e^2} \begin{bmatrix} 1 & 2 \\ y & z \end{bmatrix}$

An estimate of the accuracy can be obtained from the relations given by Kellerman:

$$\sum_x \frac{V_a}{e^1} \begin{bmatrix} 1 & 1 \\ x & x \end{bmatrix} = 0 \text{ and } \sum_x \frac{V_a}{e^2} \begin{bmatrix} 1 & 2 \\ x & x \end{bmatrix} = 0$$

These are seen to hold extremely well for all cases.

Reference

1. E. Kellerman, Phil Trans. Roy. Soc A238, 513 (1940)

24 12 0	- .7850 0 -10.9860	0 - .7880 0	0 10.9860 0	1.5761 0 0
24 10 2	- 1.5529 - .7866 - 9.8092	0 .0017 0	0 11.8640 0	1.5513 - 2.0548 - .3374
24 10 0	- 1.6427 0 -10.0388	0 .0276 0	0 11.9729 0	1.6153 - 1.9342 0
24 8 4	- 2.0772 - 1.3361 - 8.2384	0 .6539 0	0 12.4570 0	1.4234 4.2189 - .5550
24 8 2	- 2.3745 - .6857 - 8.9477	0 .7263 0	0 12.8090 0	1.6483 - 3.8613 - .2724
24 8 0	- 2.4768 0 - 9.1888	0 .7542 0	0 12.9300 0	1.7230 - 3.7412 - .2690
24 6 6	- 2.2640 - 1.5478 - 6.3337	0 1.1320 0	0 12.6675 0	1.1320 - 6.3337 - .6298
24 6 4	- 2.7790 - 1.0712 - 7.5011	0 1.2383 0	0 13.2665 0	1.5408 - 5.7654 - .4113
24 6 2	- 3.1102 - .5474 - 8.2335	0 1.3225 0	0 13.6505 0	1.7878 - 5.4171 - .2022

24 6 0	- 3.2245 0 - 8.4832	0 1.3543 0	0 13.7828 0	1.8704 - 5.2998 0
24 4 4	- 3.3358 - .7369 - 6.9529	0 1.6681 0	0 13.9060 0	1.6681 - 6.9529 - .2690
24 4 2	- 3.6947 - .3808 - 7.7005	0 1.7645 0	0 14.3162 0	1.9303 - 6.6156 - .1324
24 4 0	- 3.8188 0 - 7.9558	0 2.1671 0	0 14.458 0	2.1671 - 6.5019 0
24 2 2	- 4.0713 - .1952 - 7.3719	0 2.0357 0	0 14.7438 0	2.0357 - 7.3719 - .0651
24 2 0	- 4.2015 0 - 7.6306	0 2.0746 0	0 14.8913 0	2.1271 - 7.2610 0
24 0 0	- 4.3338 0 - 7.5205	0 2.1671 0	0 15.0410 0	2.1671 - 7.5205 0
23 11 1	- 1.2003 - .4116 -10.4248	- .4250 - .3608 .1992	- .0570 11.4012 .0046	1.5612 - .9764 - .1793
23 9 3	- 1.8612 - 1.1048 - 9.0491	- .4073 .3614 .1874	- .1692 12.1553 .0377	1.4999 - 3.1061 .4566
23 9 1	- 2.0513 - .3726 - 9.5188	- .4094 .4128 .2045	- .0578 12.3841 .0136	1.6386 - 2.8653 - .1500

23 7 5	- 2.2269	- .3551	- .2723	1.3023
	- 1.4977	.9246	12.5681	- 5.2689
	- 7.2992	.1472	.0912	- .6022
23 7 3	- 2.6350	- .3598	- .1728	1.6162
	- .9241	1.0189	13.0485	- 4.8021
	- 8.2464	.1760	.0617	- .3535
23 7 1	- 2.8499	- .3628	- .0592	1.7730
	- .3123	1.0771	13.3009	- 4.5653
	- 8.7356	.1910	.0218	- .1163
23 5 5	- 2.8433	- .2778	- .2778	1.4217
	- 1.1229	1.4217	13.2840	- 6.6419
	- 6.6419	.1226	.1226	- .5219
23 5 3	- 3.2921	- .2829	- .1772	1.7588
	- .6951	1.5334	13.8029	- 6.1904
	- 7.6125	.1450	.0815	- .2481
23 5 1	- 3.5287	- .2860	- .0609	1.9288
	- .2352	1.6000	14.0759	- 5.9607
	- 8.1153	.1566	.0286	- .0816
23 3 3	- 3.7711	- .1811	- .1811	1.8856
	- .4311	1.8856	14.3507	- 7.1754
	- 7.1754	.0957	.0957	- .1459
23 3 1	- 4.0239	- .1834	- .0624	2.0643
	- .1461	1.9597	14.6391	- 6.9525
	- 7.6866	.1031	.0335	- .0480
23 1 1	- 4.2854	- .0632	- .0632	2.1428
	- .0495	2.1428	14.9357	- 7.4679
	- 7.4679	.0360	.0360	- .0158
22 14 0	.0017	- .7866	0	1.5513
	0	- 1.5529	9.8092	2.0548
	-11.8640	.3374	0	0

22 12 2	- .7387	- .8409	- .2244	1.4776
	- .8409	- .7387	10.6723	0
	-10.6723	.3702	0	- .3702
22 12 0	- .8146	- .8411	0	1.5255
	0	- .7107	10.7718	.1176
	-10.8894	.3886	0	0
22 10 4	- 1.3255	- .8353	- .4373	1.3320
	- 1.5502	- .0065	11.3403	- 2.3037
	- 9.0366	.3446	.0615	- .6541
22 10 2	- 1.5848	- .8364	- .2262	1.5198
	- .7834	.0651	11.6650	- 1.9445
	- 9.7207	.3976	.0365	.3195
22 10 0	- 1.6741	- .8410	0	1.5813
	0	.0931	11.7769	- 1.8240
	- 9.9530	.4156	0	0
22 8 6	- 1.6514	- .7612	- .6230	1.0501
	- 1.9560	.6014	11.7066	- 4.7015
	- 7.0051	.2672	.1616	- .8075
22 8 4	- 2.1153	- .7695	- .4437	1.4168
	- 1.3497	.6985	12.2699	- 4.1182
	- 8.1516	.3438	.1282	- .5523
22 8 2	- 2.4139	- .7772	- .2309	1.6351
	- .6885	.7789	12.6306	- 3.7621
	- 8.8686	.3918	.0709	- .2562
22 8 0	- 2.5170	- .7803	0	1.7075
	0	.8096	12.7549	- 3.6423
	- 9.1126	.4081	0	0
22 6 6	- 2.2050	- .6321	- .6321	1.1526
	- 1.5424	1.1524	12.4840	- 6.2421
	- 2.2421	.2433	.2433	- .5932
22 6 4	- 2.8245	- .6443	- .4540	1.5520
	- 1.0766	1.2726	13.0985	- 5.6775
	- 7.4210	.3062	.1859	- .3854
22 6 2	- 3.1598	- .6529	- .2374	1.7934
	- .5460	1.3664	13.4930	- 5.3312
	- 8.1612	.3460	.1009	- .1887

22 6 0	- 3.2754 0 - 8.4144	- .6571 1.4015 .3596	0 13.6289 0	- 1.8740 - 5.2145 0
22 4 4	- 3.3895 - .7486 - 6.8774	- .4650 1.6948 .2308	- .4650 13.7548 .2308	1.6948 - 6.8774 - .2505
22 4 2	- 3.7543 - .3837 - 7.6340	- .4733 1.8020 .2594	- .2439 14.1768 .1243	1.9524 - 6.5428 - .1227
22 4 0	- 3.8805 0 - 7.8926	- .4763 1.8417 .2692	0 14.3224 0	- 2.0390 - 6.4299 0
22 2 2	- 4.1088 .1949 - 7.3086	- .2488 2.0695 .1393	- .2488 14.6170 .1393	2.0695 - 7.3086 - .0600
22 2 0	- 4.2717 0 - 7.5706	- .2505 2.1123 .1444	0 14.7691 0	- 2.1595 - 7.1986 0
22 0 0	- 4.4071 0 - 7.4618	0 2.2036 0	0 14.9234 0	- 2.2036 - 7.4618 0
21 13 1	- .4102 - .4244 -11.1966	- 1.2234 - 1.0360 .5466	- .1675 9.9813 - .0112	1.4462 1.2152 - .1809
21 11 3	- 1.0938 - 1.2252 - 9.7894	- 1.2634 - .2772 .5541	- .4948 10.7757 .0408	1.3711 - .9863 - .4922
21 11 1	- 1.2548 - .4127 -10.2431	- 1.2669 - .2210 .6086	- .1684 10.9908 .0164	1.4759 - .7478 - .1609

21 9 5	- 1.5682 - 1.8035 - 7.9457	- 1.2044 .3715 .4751	- .7963 11.3145 .1697	1.1967 - 3.3687 - .6980
21 9 3	- 1.9285 - 1.1112 - 8.8772	- 1.2160 .4694 .5750	- .5024 11.7725 .1201	1.4591 - 2.8952 - .4056
21 9 1	- 2.1188 - .3752 - 9.3574	- 1.2240 .5306 .6266	- .1717 12.0128 .0433	1.5884 - 2.6555 - .1327
21 7 7	- 1.7383 - 2.0145 - 5.7529	- 1.0430 .8692 .3321	- 1.0430 11.5057 .3321	.8692 - 5.7529 - .7698
21 7 5	- 2.3043 - 1.5087 - 7.1234	- 1.0599 .9895 .4546	- .8114 12.2015 .2844	1.3149 - 5.0781 - .5317
21 7 3	- 2.7183 - .9333 - 8.0905	- 1.0772 1.1060 .5415	- .5156 12.7063 .1922	1.6123 - 4.6158 - .3091
21 7 1	- 2.9372 - .3158 - 8.5910	- 1.0879 1.1765 .5866	- .1769 12.9719 .0679	1.7609 - 4.3810 - .1011
21 5 5	- 2.9335 - 1.1352 - 6.4763	- .8311 1.4668 .3791	- .8311 12.9526 .3791	1.4668 - 6.4763 - .3673
21 5 3	- 3.3946 - .7045 - 7.4684	- .8491 1.6043 .4469	- .5310 13.4993 .2522	1.7904 - 6.0309 - .2134
21 5 1	- 3.6387 - .2388 - 7.9835	- .8598 1.6853 .4823	- .1827 13.7876 .0885	1.9535 - 5.8041 - .0697
21 3 3	- 3.8905 - .4381 - 7.0389	- .5445 1.9455 .2954	- .5445 14.0778 .2954	1.9455 - 7.0389 - .1238

21 3 1	- 4.1540 - .1486 - 7.5634	- .5524 2.0355 .3181	- .1877 14.3832 .1034	2.1186 - 6.8198 - .0404
21 1 1	- 4.4272 - .0505 - 7.3490	- .1906 2.2137 .1112	- .1906 14.6980 .1112	2.2137 - 7.3490 - .0132
20 16 0	.6539 0 -12.4600	- 1.3361 - 2.0772 .5550	0 8.2384 0	1.4234 4.2189 0
20 14 2	- .0065 - .8353 -11.3403	- 1.5502 - 1.3255 .6541	- .4373 9.0366 - .0615	1.3320 2.3037 - .3446
20 14 0	- .0639 0 -11.5474	- 1.5487 - 1.2922 .6890	0 9.1324 0	1.3562 2.4148 0
20 12 4	- .6018 - 1.6522 - 9.7194	- 1.6522 - .6018 .6518	- .8499 9.7194 0	1.2037 0 - .6518
20 12 2	- .8104 - .8422 -10.3825	- 1.6607 - .5186 .7597	- .4371 10.0311 .0101	1.3291 .3513 - .3153
20 12 0	- .8827 0 -10.6070	- 1.6557 - .4866 .7962	0 10.1380 0	1.3694 .4692 0
20 10 6	- 1.0189 - 2.2605 - 7.6255	- 1.6406 .0506 .5445	- 1.2121 10.1839 .1581	.9684 - 2.5584 - .8626
20 10 4	- 1.4127 - 1.5581 - 8.7565	- 1.6517 .1591 .7135	- .8569 10.7287 .1411	1.2537 - 1.9721 - .5498

20 10 2	- 1.6681 - .7945 - 9.4626	- 1.6645 .2491 .8188	- .4440 11.0768 .0824	1.4191 - 1.6143 - .2659
20 10 0	- 1.7566 0 - 9.7027	- 1.6698 .2834 .8546	0 11.1967 0	1.4732 - 1.4939 0
20 8 8	- 1.1693 - 2.4714 - 5.1745	- 1.4858 .5847 .3612	- 1.4858 10.3490 .3612	.5847 - 5.1745 - .9375
20 8 6	- 1.7509 - 1.9697 - 6.7179	- 1.5038 .6940 .5607	- 1.2271 11.1123 .3471	1.0569 - 4.3944 - .6737
20 8 4	- 2.2178 - 1.3572 - 7.8961	- 1.5260 .8260 .7136	- .8764 11.7150 .2940	1.3911 - 3.8184 - .4291
20 8 2	- 2.5206 - .6986 - 8.6373	- 1.5485 .9315 .8100	- .4569 12.1025 .1512	1.5892 - 3.4653 - .2072
20 8 0	- 2.6258 0 - 8.8896	- 1.5539 .9709 .8430	0 12.2360 0	1.6549 - 3.3463 0
20 6 6	- 2.4158 - 1.5732 - 5.9712	- 1.2545 1.2079 .5104	- 1.2545 11.9424 .5104	1.2079 - 5.9712 - .4834
20 6 4	- 2.9503 - 1.0956 - 7.1852	- 1.2847 1.3705 .6373	- .9032 12.6017 .3904	1.5799 - 5.4165 - .3069
20 6 2	- 3.2978 - .5621 - 7.9516	- 1.3078 1.4937 .7180	- .4731 13.0269 .2119	1.8043 - 5.0754 - .1478
20 6 0	- 3.4185 0 - 8.2136	- 1.3165 1.5393 .7458	0 13.1738 0	1.8792 - 4.9603 0

20 4 4	- 3.5408 - .7595 - 6.6544	- .9303 1.7704 .4817	- .9303 13.3090 .4817	1.7704 - 6.6544 - .1940
20 4 2	- 3.9249 - .3935 - 7.4390	- .9503 1.9108 .5402	- .4891 13.7660 .2598	2.0142 - 6.3271 - .0931
20 4 0	- 4.0588 0 - 7.7077	- .9577 1.9624 .5603	0 13.9240 0	2.0962 - 6.2165 0
20 2 2	- 4.3337 - .2025 - 7.1225	- .5007 2.1670 .2905	- .5007 14.2448 .2905	2.1670 - 7.1225 - .0445
20 2 0	- 4.4758 0 - 7.3953	- .5049 2.2228 .3012	0 14.4108 0	2.2533 - 7.0155 0
20 0 0	- 4.6208 0 - 7.2897	0 2.3107 0	0 14.5800 0	2.3107 - 7.2897 0
19 15 1	.2812 - .4046 -11.7189	- 1.7977 - 1.4998 .7798	- .2686 8.1362 - .0529	1.2187 3.5827 - .1540
19 13 3	- .3649 - 1.2613 -10.3647	- 1.9985 - .7889 .8486	- .7913 8.9057 - .0421	1.1539 1.4589 - .4473
19 13 1	- .4856 - .4249 -10.8056	- 2.0007 - .7231 .9369	- .2683 9.1158 - .0100	1.2088 1.6898 - .1449
19 11 5	- .8941 - 2.0022 - 8.5021	- 2.0582 - .1391 .7838	- 1.2748 9.5048 .1077	1.0332 - 1.0027 - .6752

19 11 3	- 1.1850 - 1.2338 - 9.4216	- 2.0725 - .0252 .9585	- .7994 9.9527 .0910	1.2103 - .5311 - .3847
19 11 1	- 1.3401 - .4167 - 9.8953	- 2.0839 .0455 1.0483	- .2725 10.1871 .0351	1.2947 - .2919 - .1244
19 9 7	- 1.1935 - 2.4321 - 6.2040	- 1.9500 .4004 .5985	- 1.6774 9.8351 .3468	.7931 - 3.6310 - .7989
19 9 5	- 1.6794 - 1.8232 - 7.5775	- 1.9767 .5390 .8332	- 1.2964 10.5232 .3172	1.1405 - 2.9456 - .5355
19 9 3	- 2.0392 - 1.1291 - 8.5464	- 2.0067 .6738 .9991	- .8205 11.0219 .2222	1.3655 - 2.4756 - .3036
19 9 1	- 2.2524 - .1348 - 9.1035	- 2.0281 .7649 1.0948	- .0992 11.3137 .0283	1.4875 - 2.2102 - .0343
19 7 7	- 1.8585 - 2.0392 - 5.3632	- 1.7074 .9293 .5946	- 1.7074 10.7264 .5946	.9293 - 5.3632 - .5865
19 7 5	- 2.4353 - 1.5382 - 6.7813	- 1.7492 1.1076 .7990	- 1.3343 11.4831 .5084	1.3278 - 4.7018 - .3901
19 7 3	- 2.8628 - .9566 - 7.7892	- 1.7883 1.2703 .9454	- .8507 12.0353 .3433	1.5926 - 4.2462 - .2193
19 7 1	- 3.0909 - .3246 - 8.3132	- 1.8117 1.3664 1.0221	- .2924 12.3271 .1214	1.7245 - 4.0140 - .0703
19 5 5	- 3.0923 - 1.1659 - 6.1518	- 1.3785 1.5462 .6682	- 1.3785 12.3036 .6682	1.5462 - 6.1518 - .2566

19 5 3	- 3.5802	- 1.4172	- .8840	1.8430
	- .7274	1.7373	12.9056	- 5.7169
	- 7.1887	.7839	.4455	- .1426
19 5 1	- 3.8409	- 1.4398	- .3048	1.9925
	- .2473	1.8484	13.22477	- 5.4949
	- 7.7299	.8448	.1566	- .0453
19 3 3	- 4.1141	- .9125	- .9125	2.0571
	- .4549	2.0571	13.5465	- 6.7732
	- 6.7732	.5201	.5201	- .0783
19 3 1	- 4.3996	- .9288	- .3152	2.2194
	- .1548	2.1804	13.8871	- 6.5610
	- 7.3261	.5595	.1824	- .0247
19 1 1	- 4.6987	- .3212	- .3212	2.3495
	- .0527	2.3495	14.2396	- 7.1198
	- 7.1198	.1961	.1961	- .0077
18 18 0	1.1320	- 1.5478	0	1.1320
	0	- 2.2640	6.3337	6.3337
	-12.6674	.6299	0	0
18 16 2	.6013	- 1.9560	- .6230	1.0501
	- .7612	- 1.6514	7.0051	4.7015
	-11.7066	.8075	- .1616	- .2672
18 16 0	.5683	- 1.9530	0	1.0457
	0	- 1.6138	7.1026	4.8050
	-11.9077	.8523	0	0
18 14 4	.0506	- 2.2606	- 1.2121	.9684
	- 1.6406	- 1.0189	7.6255	2.5584
	-10.1839	.8626	- .1581	- .5445
18 14 2	- .0879	- 2.2495	- .6201	1.0104
	- .8319	- .9213	7.9366	2.8977
	-10.8220	1.0124	- .0660	- .2590
18 14 0	- .1367	- 2.2609	0	1.0222
	0	- .8854	8.0429	3.0085
	11.0513	1.0629	0	0

18 12 6	- .4087 - 2.4124 - 8.1104	- 2.4124 - .4087 .7702	- 1.7342 8.1104 0	.8175 0 - .7702
18 12 4	- .6990 - 1.6647 - 9.2292	- 2.4219 - .2804 1.0242	- 1.2166 8.6511 .0456	.9794 .5781 - .4764
18 12 2	- .8910 - .8497 - 9.9272	- 2.4372 - .1758 1.1819	- .6274 8.9945 .0381	1.0668 .9326 - .2255
18 12 0	- .9581 0 -10.1646	- 2.4441 - .1360 1.2354	0 9.1124 0	1.0942 1.0522 0
18 10 8	- .6711 - 2.8641 - 5.5831	- 2.3741 .1277 .5493	- 2.1385 8.3784 .2631	.5434 - 2.7953 - .8965
18 10 6	- 1.1361 - 2.2702 - 7.1310	- 2.3910 .2573 .8758	- 1.7504 9.1394 .2960	.8789 - 2.0083 - .6177
18 10 4	- 1.5172 - 1.5821 - 8.3131	- 2.4302 .4132 1.1251	- 1.2429 9.7380 .2530	1.1041 - 1.4249 - .3778
18 10 2	- 1.7681 - .8073 - 9.0558	- 2.4569 .5358 1.2820	- .6460 10.1220 .1452	1.2324 - 1.0660 - .1770
18 10 0	- 1.8556 0 - 9.3093	- 2.4738 .5819 1.3356	0 10.2540 0	1.2738 - .9447 0
18 8 8	- 1.2951 - 2.5035 - 4.6568	- 2.1617 .6476 .6056	- 2.1617 9.3136 .6056	.6476 - 4.6568 - .6663

18 8 6	- 1.8749 - 2.0069 - 6.2566	- 2.2103 .8273 .9012	- 1.7947 10.1496 .5756	1.0476 - 3.8930 - .4518
18 8 4	- 2.3492 - 1.4022 - 7.4908	- 2.2656 1.0218 1.1309	- 1.2880 10.8145 .4522	1.3275 - 3.3238 - .2709
18 8 2	- 2.6613 - .7211 - 8.2715	- 2.3085 1.1693 1.2773	- .6736 11.2440 .2491	1.4921 - 2.9725 - .1247
18 8 0	- 2.7703 0 - 8.5388	- 2.3246 1.2241 1.3277	0 11.3926 0	1.5462 - 2.8538 0
18 6 6	- 2.5618 - 1.6114 - 5.5312	- 1.8561 1.2818 .8217	- 1.8561 11.0160 .8217	1.2808 - 5.5312 - .2989
18 6 4	- 3.1240 - 1.1369 - 6.8063	- 1.9184 1.5169 1.0155	- 1.3436 11.7951 .6298	1.6072 - 4.9888 - .1738
18 6 2	- 3.4948 - .5830 - 7.6179	- 1.9646 1.6918 1.1404	- .7070 12.2710 .3425	1.8033 - 4.6534 - .0778
18 6 0	- 3.6246 0 - 7.8966	- 1.9816 1.7561 1.1835	0 12.4365 0	1.8685 - 4.5399 0
18 4 4	- 3.7606 - .8011 - 6.2936	- 1.3974 1.8804 .7713	- 1.3974 12.5872 .7713	1.8804 - 6.2936 - .0971
18 4 2	- 4.1813 - .4141 - 7.1281	- 1.4366 2.0796 .8632	- .7376 13.1045 .4174	2.1018 - 5.9764 - .0418

18 4 0	- 4.3286 0 - 7.4155	- 1.4509 2.1526 .8951	0 13.2846 0	2.1761 - 5.8691 0
18 2 2	- 4.6359 - .2130 - 6.8253	- .7609 2.3180 .4663	- .7609 13.6510 .4663	2.3180 - 6.8253 - .0173
18 2 0	- 4.7950 0 - 7.1180	- .7683 2.3969 .4833	0 13.8408 0	2.3982 - 6.7228 0
18 0 0	4.9585 0 - 7.0174	0 - 2.4793 0	0 14.0350 0	2.4793 - 7.0174 0
17 17 1	.8327 - .3508 -11.9041	- 2.0068 - 1.6654 .8618	- .3508 5.9520 - .1063	.8327 5.9520 - .1063
17 15 3	.2801 - 1.1975 -10.6807	- 2.4232 - 1.0747 1.0125	- 1.0347 6.6166 - .1816	.7947 4.0640 - .3324
17 15 1	.2126 - .4038 -11.1143	- 2.4239 - 1.0016 1.1210	- .3497 6.8293 - .0558	.7890 4.2849 - .1060
17 13 5	- .2474 - 2.0556 - 8.8819	- 2.6909 - .5016 1.0036	- 1.6716 7.1879 - .0703	.7490 1.6940 - .5327
17 13 3	- .4396 - 1.2694 - 9.7930	- 2.7056 - .3709 1.2361	- 1.0419 7.6353 - .0113	.8105 2.1576 - .2924
17 13 1	- .5445 - .4293 -10.2623	- 2.7187 - .2907 1.3554	- .3541 7.8680 .0018	.8352 2.3943 - .0925
17 11 7	- .6296 - 2.6952 - 6.5585	- 2.7558 .0006 .8264	- 2.2117 7.5793 .1923	.6290 - 1.0208 - .6682

17 11 5	- .9899 - 2.0270 - 7.9353	- 2.7897 .1633 1.1655	- 1.6969 8.2664 .2199	- .8266 - .3311 - .4214
17 11 3	- 1.2637 - 1.2586 - 8.9071	- 2.8307 .3200 1.4047	- 1.0687 8.7615 .1701	.9437 .1456 - .2259
17 11 1	- 1.4117 - .4268 - 9.4105	- 2.8575 .4144 1.5288	- .3651 9.0212 .0636	.9973 .3893 - .0703
17 9 9	- .7695 - 2.9321 - 3.8596	- 2.5907 .3848 .5259	- 2.5907 7.7192 .5259	.3848 - 3.8596 - .7159
17 9 7	- 1.3068 - 2.4700 - 5.6150	- 2.6365 .5471 .9190	- 2.2537 8.6164 .5667	.7597 - 3.0014 - .4849
17 9 5	- 1.7857 - 1.8717 - 7.0548	- 2.7036 .7593 1.2431	- 1.7532 9.3763 .5084	1.0265 - 2.3215 - .2933
17 9 3	- 2.1476 - 1.1683 - 8.0806	2.7673 .9528 1.4757	- 1.1147 9.9306 .3530	1.1948 1.8500 - .1501
17 9 1	- 2.3429 - .3972 - 8.6151	- 2.8057 1.0674 1.5977	- .3827 10.2236 .1264	1.2756 - 1.6084 - .0452
17 7 7	- 1.9772 - 2.0982 - 4.7983	- 2.3274 .9887 .9098	- 2.3274 9.5968 .9098	.9887 - 4.7983 - .3125
17 7 5	- 2.5740 - 1.6005 - 6.2898	- 2.4139 1.2570 1.1983	- 1.8319 10.4384 .7777	1.3171 - 4.1486 - .1752

17 7 3	- 3.0253	- 2.4901	- 1.1743	1.5326
	- 1.0036	1.4928	11.0587	- 3.6969
	- 7.3619	1.4084	.5258	- .0814
17 7 1	- 3.2691	- 2.5346	- .4048	1.6387
	- .3420	1.6305	11.3889	- 3.4653
	- 7.9236	1.5195	.1861	- .0227
17 5 5	- 3.2773	- 1.9176	- 1.9176	1.6387
	- 1.2274	1.6387	11.3601	- 5.6800
	- 5.6800	1.0077	1.0077	- .0858
17 5 3	- 3.8107	- 1.9907	- 1.2373	1.8956
	- .7725	1.9153	12.0452	- 5.2560
	- 6.7893	1.1771	.6751	- .0320
17 5 1	- 4.0996	- 2.0328	- .4280	2.0244
	- .2638	2.0753	12.4119	- 5.0386
	- 7.3733	1.2674	.2379	- .0070
17 3 3	- 4.4083	- 1.2903	- 1.2003	2.2042
	- .4875	2.2042	12.7831	- 6.3916
	- 6.3916	.7860	.7860	- .0062
17 3 1	- 4.7326	- 1.3207	- .4474	2.3507
	- .1667	2.3820	13.1796	- 6.1880
	- 6.9916	.8454	.2766	.0004

17 1 1	- 5.0766 - .0570 - 6.7964	- .4585 2.5383 .2974	- .4585 13.5929 .2974	2.5383 - 6.7964 .0010
16 16 4	.5847 - 1.4858 -10.3490	- 2.4714 - 1.1693 .9375	- 1.4858 5.1745 - .3612	.5847 5.1750 - .3612
16 16 2	.5334 - .7577 -10.9912	- 2.4791 - 1.0667 1.1031	- .7577 5.4956 - .1664	.5334 5.4956 - .1664
16 16 0	.5140 0 -11.2090	- 2.4681 - 1.0279 1.1590	0 5.6044 0	.5140 5.6044 0
16 14 6	.1277 - 2.3741 - 8.3784	- 2.8641 - .6711 .8966	- 2.1385 5.5831 - .2631	.5434 2.7953 - .5493
16 14 4	- .0236 - 1.6442 - 9.4897	- 2.8713 - .5280 1.2020	- 1.4896 6.1313 - .1260	.5517 3.3583 - .3200
16 14 2	- .1303 - .8412 -10.1832	- 2.8876 - .4129 1.3913	- .7649 6.4758 - .0464	.5433 3.7073 - .1444
16 14 0	- .1687 0 -10.4190	- 2.8951 - .3694 1.4555	0 6.5934 0	.5382 3.8257 0
16 12 8	- .2083 - 3.0374 - 5.8639	- 3.0374 - .2083 .6829	- 2.6552 5.8639 0	.4166 0 - .6829
16 12 6	- .5017 - 2.4293 - 7.4144	- 3.0619 - .0581 1.1089	- 2.1541 6.6302 .1076	.5599 .7842 - .4306

16 12 4	- .7556 - 1.6908 - 8.5990	- 3.1001 .1193 1.4334	- 1.5202 7.2264 .1333	.6364 1.3927 - .2387
16 12 2	- .9281 - .8705 - 9.3441	- 3.1459 .2580 1.6376	- .7868 7.6057 .0874	.6701 1.7384 - .1027
16 12 0	- .9892 0 - 9.5986	- 3.1548 .3100 1.7074	0 7.7362 0	.6793 1.8624 0
16 10 10	- .3320 - 3.2887 - 2.9821	- 2.9707 .1661 .3511	- 2.9707 5.9642 .3511	.1661 - 2.9821 - .7312
16 10 8	- .7793 - 2.8914 - 4.8646	- 3.0006 .2895 .8384	- 2.6826 6.9073 .4661	.4899 - 2.0426 - .4867
16 10 6	- 1.2146 - 2.3314 - 6.4847	- 3.0700 .4997 1.2587	- 2.2133 7.7437 .4877	.7150 - 1.2591 - .2830
16 10 4	- 1.5826 - 1.6371 - 7.7375	- 3.1507 .7265 1.5858	- 1.5818 8.4059 .4040	.8561 - .6684 - .1393
16 10 2	- 1.8298 - .8447 - 8.5320	- 3.2139 .8986 1.7946	- .8252 8.8325 .2287	.9312 - .3005 - .0575
16 10 0	- 1.9171 0 - 8.8045	- 3.2376 .9627 1.8665	0 8.9801 0	.9544 - .1755 0

16 8 8	- 1.3840 - 2.5619 - 3.9647	- 2.7586 .6920 .9079	- 2.7586 7.9296 .9079	.6920 - 3.9647 - .2945
16 8 6	- 1.9650 - 2.0880 - 5.6435	- 2.8038 .9723 1.2984	- 2.3104 8.8536 .8565	.9928 - 3.2101 - .1416
16 8 4	- 2.4538 - 1.4710 - 6.9573	- 2.9713 1.2577 1.6083	- 1.6715 9.5969 .6713	1.1692 - 2.6396 - .0462
16 8 2	- 2.7817 - .7645 - 7.7977	- 3.0510 1.4698 1.8088	- .8776 10.0812 .3697	1.3119 - 2.2834 - .0063
16 8 0	- 2.8975 0 - 8.0872	- 3.0807 1.5482 1.8784	0 10.2300 0	1.3494 - 2.1624 0
16 6 6	- 2.6856 - 1.7102 - 4.9366	- 2.4288 1.3428 1.1893	- 2.4288 9.8732 1.1893	1.3428 - 4.9366 - .0353
16 6 4	- 3.2927 - 1.2155 - 6.3026	- 2.5437 1.6877 1.4578	- 1.7728 10.7043 .9163	1.6052 - 4.4017 .0196
16 6 2	- 3.7013 - .6320 - 7.1832	- 2.6275 1.9410 1.6337	- .9373 11.2513 .5002	1.7604 - 4.0681 .0250
16 6 0	- 3.8458 0 - 7.4879	- 2.6582 2.0342 1.6950	0 11.4425 0	1.8116 - 3.9546 0
16 4 4	4.0028 - .8643 - 5.8083	- 1.8727 2.0015 1.1166	- 1.8727 11.6170 1.1166	2.0015 -5.8083 .0464

16 4 2	- 4.4823 - .4524 - 6.7210	- 1.9410 2.2909 1.2490	- .9936 12.2217 .6078	2.1915 - 5.5008 .0349
16 4 0	- 4.6528 0 - 7.0379	- 1.9694 2.3973 1.2955	0 12.4340 0	2.2551 - 5.3963 0
16 2 2	- 5.0113 - .2364 - 6.4343	- 1.0342 2.5057 .6794	- 1.0342 12.8687 .6794	2.5057 - 6.4343 .0239
16 2 0	- 5.1991 0 - 6.7593	- 1.0490 2.6211 .7046	0 13.0965 0	2.5781 - 6.3373 0
16 0 0	- 5.3938 0 - 6.6650	0 2.6968 0	0 13.330 0	2.6968 - 6.6650 0
15 15 5	.3165 - 1.9429 - 9.0172	- 2.9246 - .6330 1.0833	- 1.9429 4.5086 - .3086	.3165 4.5086 - .3086
15 15 3	.2476 - 1.2046 - 9.9251	- 2.9391 - .4952 1.3376	- 1.2046 4.9625 - .1540	.2476 4.9625 - .1540
15 15 1	- .2055 - .4082 -10.3929	- 2.9528 - .4110 1.4681	- .4082 5.1964 - .0456	.2055 5.1964 - .0456
15 13 7	- .1012 - 2.7542 - 6.7549	- 3.2309 - .2303 .9583	- 2.5871 4.8581 - .0866	.3316 1.8967 - .4059
15 13 5	- .2896 - 2.0826 - 8.1334	- 3.2686 - .0510 1.3609	- 1.9700 5.5466 .0224	.3406 2.5867 - .2156

15 13 3	- .4443 - 1.2984 - 9.1070	- 3.3163 .1203 1.6449	- 1.2343 6.0367 .0528	.3241 3.0702 - .0943
15 13 1	- .5315 - .4413 - 9.6117	- 3.3478 .2233 1.7921	- .4206 6.2921 - .0248	.3082 3.3197 - .0250
15 11 9	- .3459 - 3.2340 - 4.0170	- 3.2816 .0800 .6602	- 3.0563 5.0525 .2724	.2659 - 1.0355 - .4577
15 11 7	- .6883 - 2.7434 - 5.7889	- 3.3400 .2651 1.1680	- 2.6377 5.9497 .3770	.4232 - .1609 - .2417
15 1 5	- 1.0129 - 2.0921 - 7.2449	- 3.4284 .5055 1.5870	- 2.0399 6.7015 .3796	.5074 .5434 - .0926
15 11 3	- 1.2681 - 1.3120 - 8.2848	- 3.5131 .7246 1.8882	- 1.2920 7.2462 .2793	.5435 1.0385 - .0173
15 11 1	- 1.4088 - .4473 - 8.8276	- 3.5644 .8542 2.0463	- .4427 7.5331 .1025	.5546 1.2945 .0013
15 9 9	- .8360 - 2.9895 - 3.0472	- 3.1203 .4180 .8036	- 3.1203 6.0945 .8036	.4180 - 3.0472 - .2475
15 9 7	- 1.3475 - 2.5620 - 4.8792	- 3.2327 .6852 1.2923	- 2.7423 7.0739 .8418	.6624 - 2.1947 - .0751
15 9 5	- 1.8209 - 1.9699 - 6.4075	- 3.3653 .9997 1.7056	- 2.1523 7.9126 .7457	.8213 - 1.5052 .0292

15 9 3	- 2.1890 - 1.2427 - 7.5118	- 3.4824 1.2774 2.0082	- 1.3776 8.5307 .5151	.9117 - 1.0189 .0575
15 9 1	- 2.3911 - .4249 - 8.0927	- 3.5510 1.4399 2.1689	- .4746 8.8697 .1841	.9512 - .7671 .0266
15 7 7	- 2.0274 - 2.2158 - 4.0770	- 2.8868 1.0137 1.2805	- 2.8868 8.1539 1.2805	1.0137 - 4.0770 .0544
15 7 5	- 2.6545 - 1.7169 - 5.6699	- 3.0441 1.4066 1.6598	- 2.2958 9.0970 1.0987	1.2480 - 3.4272 .1191
15 7 3	- 3.1421 - 1.0892 - 6.8342	- 3.1788 1.7475 1.9424	- 1.4834 9.8028 .7459	1.3947 - 2.9686 .1104
15 7 1	- 3.4104 - .3736 - 7.4513	- 3.2568 1.9461 2.0942	- .5136 10.1823 .2646	1.4644 - 2.7310 .0441
15 5 5	- 3.4259 - 1.3391 - 5.0741	- 2.4472 1.7130 1.4095	- 2.4472 10.1480 1.4095	1.7130 - 5.0741 .1538
15 5 3	- 4.0288 - .8537 - 6.2903	- 2.5753 2.1136 1.6445	- 1.5937 10.9451 .9519	1.9153 - 4.6549 .1260
15 5 1	- 4.3617 - .2936 - 6.9393	- 2.6492 2.3467 1.7719	- .5541 11.3775 .3370	2.0152 - 4.4382 .0483

15 3 3	- 4.7253	- 1.6868	- 1.6868	2.3627
	- .5463	2.3627	11.8199	- 5.9099
	- 5.9099	1.1094	1.1094	.0988
15 3 1	- 5.1114	- 1.7405	- .5883	2.4884
	- .1882	2.6231	12.2976	- 5.7143
	- 6.5833	1.1953	.3926	.0373
15 1 1	- 5.5281	- .6080	- .6080	2.7640
	- .0649	2.7640	12.8018	- 6.4009
	- 6.4009	.4231	.4231	.0140
14 14 8	.1661	- 3.2887	- 2.9707	.1616
	- 2.9707	- .3320	2.9820	2.9820
	- 5.9642	.7312	- .3511	- .3511
14 14 6	.0867	- 3.3045	- 2.3886	.0867
	- 2.3886	- .1734	3.7578	3.7578
	- 7.5156	1.1951	- .1620	- .1620
14 14 4	- .0064	- 3.3571	- 1.6759	- .0064
	- 1.6759	.0128	4.3506	4.3506
	- 8.7012	1.5483	- .0492	- .0492
14 14 2	- .0789	- 3.3929	- .8634	- .0789
	- .8634	.1579	4.7235	4.7235
	- 9.4472	1.7704	- .0047	- .0047
14 14 0	- .1061	- 3.4173	0	- .1061
	0	.2122	4.8509	4.8509
	- 9.7019	1.8463	0	0
14 12 10	- .0566	- 3.4646	- 3.3539	.1133
	- 3.4646	- .0566	3.0860	0
	- 3.0860	.4012	0	- .4012
14 12 8	- .2617	- 3.4985	- 3.0004	.1819
	- 3.0706	.0799	4.0335	.9465
	- 4.9800	.9775	.1779	- .1753

14 12 6	- .4939 - 2.4944 - 6.6116	- 3.5812 .3097 1.4747	- 2.4571 4.8592 .2693	.1842 1.7523 - .0167
14 12 4	- .7080 - 1.7622 - 7.8755	- 3.6785 .5570 1.8619	- 1.7465 5.5047 .2580	.1511 2.3708 .0563
14 12 2	- .8592 - .9129 - 8.6784	- 3.7550 .74446 2.1093	- .9083 5.9173 .1558	.1146 2.7611 .0513
14 12 0	- .9138 0 - 8.9541	- 3.7838 .8143 2.1946	0 6.0594 0	.0994 2.8947 0
14 10 10	- .3913 - 3.3228 - 2.0663	- 3.3916 .1957 .6013	- 3.3916 4.1325 .6013	.1957 - 2.0663 - .1776
14 10 8	- .7824 - 2.9810 - 4.0150	- 3.4952 .4233 1.1725	- 3.0977 5.1442 .7237	.3591 - 1.1292 .0160
14 10 6	- 1.1847 - 2.4432 - 5.7236	- 3.6398 .7402 1.6796	- 2.5836 6.0505 .7262	.4460 - .3267 .1376
14 10 4	- 1.5388 - 1.7414 - 7.0672	- 3.7874 1.0639 2.0841	- 1.8609 6.7751 .5902	.4750 .2921 .1662
14 10 2	- 1.7835 - .9054 - 7.9300	- 3.8979 1.3054 2.3469	- .9770 7.2461 .3314	.4782 .6839 .1090
14 10 0	- 1.8710 0 - 8.2279	- 3.9385 1.3948 2.4383	0 7.4096 0	.4763 .8183 0

14 8 8	- 1.3633 - 2.7023 - 3.1240	- 3.2540 .6817 1.2581	- 3.2540 6.2480 1.2581	- .6817 - 3.1240 .1748
14 8 6	- 1.9474 - 2.2389 - 4.9042	- 3.4445 1.0929 1.7457	- 2.7582 7.2626 1.1853	- .8546 - 2.3585 .2606
14 8 4	- 2.4571 - 1.6066 - 6.3255	- 3.6299 1.5021 2.1436	- 2.0140 8.0921 .9309	- .9551 - 1.7667 .2514
14 8 2	- 2.8082 - .8407 - 7.2487	- 3.7657 1.8051 2.4065	- 1.0655 8.6399 .5139	1.0032 - 1.3911 .1529
14 8 0	- 2.9339 0 - 7.5695	- 3.8157 1.9171 2.4987	0 8.8318 0	1.0169 - 1.2622 0
14 6 6	- 2.7128 - 1.8688 - 4.2013	- 2.9662 1.3566 1.6145	- 2.9662 8.4027 1.6145	1.3566 - 4.2013 3.1656
14 6 4	- 3.3835 - 1.3530 - 5.6941	- 3.1582 1.8508 1.9721	- 2.1887 9.3531 1.2556	1.5328 - 3.6591 .2845
14 6 2	- 3.8478 - .7103 - 6.6749	- 3.3057 2.2166 2.2121	- 1.1688 9.9905 .6902	1.6311 - 3.3156 .1682
14 6 0	- 4.0140 0 - 7.0178	- 3.3532 2.3519 2.2970	0 10.2156 0	1.6623 - 3.1978 0
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14 4 2	- 4.7693 - .5197 - 6.2406	- 2.4767 2.5212 1.7180	- 1.2633 11.1477 .8412	- 2.2483 - 4.9071 .1451
14 4 0	- 4.9744 0 - 6.6026	- 2.5214 2.6773 1.7846	0 11.4058 0	- 2.2972 - 4.8033 0
14 2 2	- 5.4148 - 2.7475 - 5.9701	- 1.3367 2.7077 .9448	- 1.3367 11.9400 .9448	- 2.7077 - 5.9701 .0844
14 2 0	- 5.6485 0 - 6.3451	- 1.3600 2.8783 .9819	0 12.2231 0	- 2.7702 - 5.8780 0
14 0 0	- 5.8925 0 - 6.2578	0 2.9463 0	0 12.5157 0	- 2.9463 - 6.2578 0
13 13 9	.0166 - 3.2812 - 4.0734	- 3.5394 - .0330 .7102	- 3.2812 2.0367 - .0919	.0166 2.0367 - .0919
13 13 7	- .0805 2.8072 - 5.8510	- 3.6029 .1611 1.2619	2.8072 2.9255 .0777	- .0805 2.9255 .0777
13 13 5	- .2062 - 2.1560 - 7.3131	- 3.6996 .4126 1.7173	- 2.1560 3.6565 .1570	- .2062 3.6565 .1570
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13 11 11	- .1010 - 3.5406 - 1.0435	- 3.5587 .0505 .3218	- 3.5587 2.0870 .3218	- .0505 - 1.0435 - .0925
13 11 9	- .3308 - 3.3057 - 3.0725	- 3.6375 .2154 .9500	- 3.3556 3.1152 .5100	- .1154 - .0428 .1202
13 11 7	- .6107 - 2.8603 - 4.9245	- 3.7761 .5056 1.5294	- 2.9291 4.0655 .6052	.1052 .8590 .2646
13 11 5	- .8952 - 2.2177 - 6.4745	- 3.9398 .8481 2.0210	- 2.2874 4.8691 .5734	.0472 1.6054 .3070
13 11 3	- 1.1291 - 1.4076 - 7.5983	- 4.0848 1.1513 2.3823	- 1.4592 5.4563 .4109	- .0221 2.1420 .2405
13 11 1	- 1.2616 - .4829 - 8.1908	- 4.1700 1.3292 2.5747	- .5019 5.7674 .1493	- .0675 2.4234 .0906
13 9 9	- .7626 - 3.1248 - 2.1068	- 3.5048 .3813 1.1175	- 3.5048 4.2136 1.1175	.3813 - 2.1068 .3106
13 9 7	- 1.2421 - 2.7351 - 4.0293	- 3.7103 .7769 1.6957	- 3.1207 5.2610 1.1539	.4652 - 1.2318 .4282
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13 9 3	- 2.0842 - 1.3698 - 6.8757	- 4.1272 1.6141 2.5799	- 1.6003 6.8535 .7030	.4701 .0222 .3246

13 9 1	- 2.2954 - .4718 - 7.5189	- 4.2392 1.8430 2.7849	- .5540 7.2199 .2515	.4525 .2990 .1200
13 7 7	- 1.9292 - 2.4211 - 3.2176	- 3.3648 .9647 1.6920	- 3.3648 6.4350 1.6920	.9647 -3.2176 .5206
13 7 5	- 2.5935 1.9151 - 4.9430	- 3.6240 1.5187 2.1748	- 2.7144 7.4846 1.4649	1.0749 -2.5417 .5044
13 7 3	- 3.1298 - 1.2342 - 6.2341	- 3.8454 2.0031 2.5458	- 1.7737 8.2871 1.0027	1.1268 -2.0530 .3677
13 7 1	- 3.4322 - .4269 - 6.9298	- 3.9740 2.2878 2.7492	- .6179 8.7254 .3575	1.1445 -1.7956 .1349
13 5 5	- 3.4546 - 1.5289 - 4.3432	- 2.9640 1.7274 1.8758	- 2.9640 8.6863 1.8758	1.7274 -4.3432 .4788
13 5 3	- 4.1558 - .9925 - 5.7120	- 3.1776 2.3008 2.1980	- 1.9570 9.6243 1.2832	1.8551 -3.9123 .3462
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13 1 1	- 6.0135 - .0788 - 5.9586	- .7787 3.0068 .5836	- .7787 11.9172 .5836	3.0068 - 5.9586 .0334
12 12 12	0 - 3.6153 0	- 3.6153 0 0	- 3.6153 0 0	0 0 0
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12 12 8	- .1616 - 3.1735 - 4.0329	- 3.7720 .3232 1.2742	- 3.1735 2.0165 .3940	- .1612 2.0165 .3940
12 12 6	- .3268 - 2.6266 - 5.7526	- 3.9323 .6538 1.8266	- 2.6266 2.8763 .4603	- .3268 2.8763 .4603
12 12 4	- .4960 - 1.8831 - 7.1346	- 4.0968 .9921 2.2679	- 1.8831 3.5536 .4034	- .4960 3.5536 .4034
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12 10 6	- .9763 - 2.6445 - 4.8871	- 4.0661 .9407 2.1004	- 2.8356 4.1167 .9862	.0356 .7703 .6412
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12 10 2	- 1.5509 - 1.0076 - 7.2910	- 4.4740 1.7219 2.9031	- 1.0911 5.3986 .4456	- .1709 1.8925 .3103
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12 8 8	- 1.1608 - 2.9344 - 2.1616	- 3.6223 .5799 1.6242	- 3.6223 4.3232 1.6242	.5799 - 2.1616 .7405
12 8 6	- 1.7399 - 2.4885 - 4.0643	- 3.9220 1.1497 2.2136	- 3.1158 5.4131 1.5390	.5903 - 1.3488 .7624
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11 11 11	0 - 3.6248 0	- 3.6248 0 .5627	- 3.6248 0 .5627	0 0 .5627
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11 11 3	- .7817 - 1.5577 - 6.8920	- 4.4927 1.5635 2.8313	- 1.5577 3.4460 .5472	- .7817 3.4460 .5472
11 11 1	- .9019 - .5383 - 7.5452	- 4.6192 1.8039 3.0579	- .5383 3.7726 .1980	.9019 3.7726 .1980
11 9 9	- .4927 - 3.3589 - 1.0762	- 3.7120 .2464 1.4203	- 3.7120 2.1523 1.4203	.2464 - 1.0762 .9469
11 9 7	- .9226 - 3.0136 - 3.0985	- 4.0281 .7869 2.0801	- 3.3586 3.2342 1.4629	.1358 - .1358 1.0236
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11 9 1	- 1.9650 - .5452 - 6.9336	- 4.8255 2.2462 3.4002	- .6163 5.3238 .3230	- .2810 1.6098 .2387
11 7 7	- 1.5990 - 2.7447 - 2.2367	- 3.7271 .7995 2.1048	- 3.7271 4.4734 2.1048	.7995 - 2.2367 1.0965
11 7 5	- 2.2944 - 2.2288 - 4.1270	- 4.1216 1.5510 2.7085	- 3.0655 5.6157 1.8509	.7435 - 1.4888 1.0002
11 7 3	- 2.8843 - 1.4662 - 5.5881	- 4.4644 2.2247 3.1921	- 2.0348 6.5152 1.2842	.6597 - .9272 .7093
11 7 1	- 3.2281 - .5130 - 6.3940	- 4.6667 2.6287 3.4649	- .7152 7.0171 .4615	.5994 - .6231 .2575
11 5 5	- 3.2564 - 1.8356 - 3.4872	- 3.4544 1.6283 2.3916	- 3.4544 - 6.9744 2.3916	1.6283 - 3.4872 .9177
11 5 3	- 4.0854 - 1.2218 - 5.0698	- 3.7981 2.4377 2.8379	- 2.3277 8.0793 1.6689	1.6477 - 3.0096 .6555
11 5 1	- 4.5746 - .4304 - 5.9585	- 4.0038 2.9307 3.0952	- .8252 8.7100 .6021	1.6440 - 2.7516 .2391
11 3 3	- 5.1378 - .8215 - 4.6926	- 2.5911 2.5689 1.9945	- 2.5911 9.3852 1.9945	2.5689 - 4.6926 .4717
11 3 1	- 5.7673 - .2911 - 5.6525	- 2.7507 3.1382 2.1855	- .9251 10.1450 .7228	2.6292 - 4.4923 .1729

11 1 1	- 6.4868 - .1035 - 5.4946	- .9862 3.2434 .7944	- .9862 10.9891 .7944	3.2434 - 5.4946 .0636
10 10 10	0 - 3.6553 0	- 3.6553 0 1.1141	- 3.6553 0 1.1141	0 0 1.1141
10 10 8	- .2371 - 3.4349 - 2.0895	- 3.9485 .4742 1.7992	- 3.4349 1.0447 1.2521	- .2371 1.0447 1.2521
10 10 6	- .5344 - 2.9468 - 4.0144	- 4.2995 1.0689 2.4534	- 2.9468 2.0073 1.2234	- .5344 2.0073 1.2234
10 10 4	- .8331 - 2.1722 - 5.5999	- 4.6284 1.6664 3.0100	- 2.1722 2.7999 .9874	- .8331 2.7999 .9874
10 10 2	- 1.0577 - 1.1593 - 6.6563	- 4.8826 2.1156 3.3899	- 1.1593 3.3282 .5547	- 1.0577 3.3282 .5547
10 10 0	- 1.1415 0 - 7.0286	- 4.9661 2.2832 3.5256	0 3.5143 0	- 1.1415 3.5143 0
10 8 8	- .7132 - 3.2848 - 1.1069	- 3.8085 .3567 1.9475	- 3.8085 2.2138 1.9475	.3567 - 1.1069 1.4003
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10 8 4	- 1.8005 - 2.1462 - 4.8805	- 4.6702 1.8711 3.2527	- 2.5205 4.3073 1.5000	- .0705 .5732 1.1173
10 8 2	- 2.2013 - 1.1567 - 6.0637	- 4.9893 2.4581 3.6840	- 1.3632 4.9739 .8421	- .2567 1.0898 .6320
10 8 0	- 2.3510 0 - 6.4869	- 5.1085 2.6798 3.8407	0 5.2134 0	- .3288 1.2734 0
10 6 6	- 2.1021 - 2.5463 - 2.3417	- 3.8268 1.0511 2.5408	- 3.8268 4.6837 2.5408	1.0511 - 2.3417 1.3611
10 6 4	- 2.9288 - 1.9384 - 4.2255	- 4.2943 1.9904 3.1595	- 2.9407 5.8902 2.0530	.9384 - 1.6648 1.1207
10 6 2	- 3.5558 - 1.0590 - 5.5487	- 4.6681 2.7289 3.6100	- 1.6184 6.7527 1.1606	.8269 - 1.2039 .6402
10 6 0	- 3.7922 0 - 6.0298	- 4.7955 3.0120 3.7768	0 7.0690 0	.7802 - 1.0392 0
10 4 4	- 4.0662 - 1.5018 - 3.6856	- 3.3729 2.0331 2.5824	- 3.3729 7.3711 2.5824	2.0331 - 3.6856 .9354
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10 2 2	- 6.0488 - .4634 - 4.8838	- 2.0957 3.0245 1.7154	- 2.0957 9.7674 1.7154	3.0245 - 4.8838 .3148
10 2 0	- 6.4753 0 - 5.4689	- 2.1734 3.4168 1.8078	0 10.2622 0	3.0586 - 4.7933 0
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9 9 9	0 - 3.6983 0	- 3.6983 0 1.6435	- 3.6983 0 1.6435	0 0 1.6435
9 9 7	- .3449 - 3.4102 - 2.1237	- 4.1245 .6899 2.3661	- 3.4102 1.0618 1.7043	- .3449 1.0618 1.7043
9 9 5	- .7392 - 2.7994 - 4.0475	- 4.5835 1.4785 3.0517	- 2.7994 2.0237 1.5254	- .7392 2.0237 1.5254
9 9 3	- 1.0956 - 1.8567 - 5.5448	- 4.9847 2.1912 3.6055	- 1.8567 2.7724 1.0708	- 1.0956 2.7724 1.0708
9 9 1	- 1.3104 - .6525 - 6.3749	- 5.2225 2.6209 3.9198	- .6525 3.1874 .3871	- 1.3104 3.1874 .3871
9 7 7	- .9647 - 3.2119 - 1.1530	- 3.9136 .4824 2.4453	- 3.9136 2.3059 2.4453	.4824 - 1.1530 1.7914
9 7 5	- 1.6568 - 2.6937 - 3.2360	- 4.4697 1.4607 3.1843	- 3.3020 3.4955 2.2005	.1962 - .2595 1.6304

9 7 3	- 2.2842 - 1.8195 - 4.9182	- 4.9706 2.3762 3.8088	- 2.2398 4.4685 1.5581	- .0919 .4497 1.1625
9 7 1	- 2.6664 - .6463 - 5.8772	- 5.2746 2.9428 4.1749	- .7974 5.0275 .5667	- .2764 .8497 .4242
9 5 5	- 2.6995 - 2.3112 - 2.4912	- 3.8766 1.3498 2.9084	- 3.8766 4.9823 2.9084	1.3498 - 2.4912 1.5138
9 5 3	- 3.6711 - 1.5930 - 4.3669	- 4.4136 2.4750 3.5359	- 2.6923 6.2634 2.0915	1.1962 - 1.8966 1.0997
9 5 1	- 4.2773 - .5728 - 5.4704	- 4.7492 3.1936 3.9171	- .9719 7.0286 .7684	1.0838 - 1.5582 .4060
9 3 3	- 5.0049 - 1.1187 - 3.9413	- 3.1304 2.5025 2.5847	- 3.1304 7.8826 2.5847	2.5025 - 3.9413 .8133
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9 1 1	- 6.8922 - .1492 - 5.0286	- 1.2580 3.4461 1.0822	- 1.2580 10.0571 1.0822	3.4461 - 5.0286 .1142
8 8 8	0 - 3.7635 0	- 3.7635 0 2.1409	- 3.7635 0 2.1409	0 0 2.1409
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8 8 4	- .9634 - 2.6116 - 4.1204	- 4.9023 1.9269 3.6480	- 2.6116 2.0602 1.7164	- .9634 2.0602 1.7164
8 8 2	- 1.3585 - 1.4338 - 5.4930	- 5.3326 2.7171 4.1840	- 1.4338 2.7465 .9787	- 1.3585 2.7465 .9787
8 8 0	- 1.5111 0 - 5.9900	- 5.5127 3.0222 4.3838	0 2.9974 0	- 5.5127 2.9974 0
8 6 6	- 1.2645 - 3.1280 - 1.2225	- 4.0219 .6323 2.9033	- 4.0219 2.4449 2.9033	.6323 - 1.2225 2.1043
8 6 4	- 2.1276 - 2.4786 - 3.3764	- 4.7015 1.8693 3.7045	- 3.2019 3.7258 2.4242	.2584 - .3495 1.7683
8 6 2	- 2.8317 - 1.3925 - 4.9765	- 5.2497 2.9004 4.3267	- 1.8041 4.6892 1.4057	- .0686 .2872 1.0290
8 6 0	- 3.1087 0 - 5.5788	- 5.4644 3.3099 4.5661	0 5.0542 0	- .2011 .5246 0
8 4 4	- 3.4358 - 2.0252 - 2.7064	- 3.8746 1.7180 3.1712	- 3.8746 5.4133 3.1712	1.7180 - 2.7066 1.5282
8 4 2	- 4.5489 - 1.1629 - 4.5476	- 4.4296 3.0005 3.7848	- 2.2352 6.7626 1.8786	1.5484 - 2.2151 .9102
8 4 0	- 4.9998 0 - 5.2631	- 4.6667 3.5268 4.0293	0 7.2934 0	1.4727 - 2.0300 0

8 2 2	- 6.0684 - .6825 - 4.2521	- 2.6164 3.0342 2.2852	- 2.6164 8.5043 2.2852	3.0342 - 4.2521 .5530
8 2 0	- 6.6998 0 - 5.0665	- 2.7747 3.6614 2.4520	0 9.2111 0	3.0384 - 4.1446 0
8 0 0	- 7.4138 0 - 4.9995	0 3.7071 0	0 9.9995 0	3.7071 - 4.9993 0
7 7 7	0 - 3.8262 0	- 3.8262 0 2.5974	- 3.8262 0 2.5974	0 0 2.5974
7 7 5	- .6076 - 3.3339 - 2.2880	- 4.5399 1.2154 3.4594	- 3.3339 1.1439 2.4104	- .6076 1.1439 2.4104
7 7 3	- 1.2119 - 2.3277 - 4.2433	- 5.2181 2.4239 - 4.2383	- 2.3277 2.1216 1.7556	- 1.2119 2.1216 1.7556
7 7 1	- 1.6035 - .8434 - 5.4092	- 5.6477 3.2070 4.7186	- .8434 2.7046 .6497	- 1.6035 2.7046 .6497
7 5 5	- 1.6401 - 3.0147 - 1.3291	- 4.1250 .8201 3.3101	- 4.1250 2.6580 3.3101	.8201 - 1.3291 2.3197
7 5 3	- 2.7142 - 2.1813 - 3.5893	- 4.9300 2.3508 4.1890	- 2.9948 4.0685 2.4887	.3635 - .4792 1.7504
7 5 1	- 3.4419 - .8088 - 5.0160	- 5.4692 3.4029 4.7656	- 1.1123 4.9689 .9408	.0390 .0471 .6628

7 3 3	- 4.3742 - 1.6378 - 3.0198	- 3.7227 2.1871 3.2618	- 3.7227 6.0396 3.2618	2.1871 - 3.0198 1.3704
7 3 1	- 5.5634 - .6228 - 4.7236	- 4.2410 3.5223 3.8028	- 1.4198 7.3888 1.2634	2.0411 - 2.6653 .5322
7 1 1	- 7.1469 - .2412 - 4.5630	- 1.6484 3.5735 1.4997	- 1.6484 9.1260 1.4997	3.5735 - 4.5630 .2105
6 6 6	0 3.9084 0	- 3.9084 0 3.0057	- 3.9084 0 3.0057	0 0 3.0057
6 6 4	- .7800 - 3.2448 - 2.4522	- 4.7865 1.5601 3.9865	- 3.2448 1.2261 2.6220	- .7800 1.2261 2.6220
6 6 2	- 1.4856 - 1.8993 - 4.4183	- 5.5691 2.9713 4.8158	- 1.8993 2.2092 1.5766	- 1.4856 2.2092 1.5766
6 6 0	- 1.7804 0 - 5.1962	- 5.8754 3.5608 5.1524	0 2.5980 0	- 1.7804 2.5980 0
6 4 4	- 2.1404 - 2.8427 - 1.4968	- 4.2080 1.0702 3.6497	- 4.2080 2.9936 3.6497	1.0702 - 1.4968 2.4088
6 4 2	- 3.4723 - 1.7403 - 3.8931	- 5.1312 2.9228 4.6122	- 2.5819 4.5793 2.2952	.5495 - .6862 1.5178
6 4 0	- 4.0620 0 - 4.9054	- 5.5363 3.7505 5.0306	0 5.2552 0	.3116 - .3499 0

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5 5 5	0 - 3.9747 0	- 3.9747 0 3.3596	- 3.9747 0 3.3596	0 0 3.3596
5 5 3	- 1.0003 - 3.0714 - 2.7126	- 5.0729 2.0007 4.5122	- 3.0714 1.3563 2.6891	1.0003 1.3563 2.6891
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5 1 1	- 7.0671 - .4579 - 4.0436	- 2.2752 3.5335 2.1624	- 2.2752 8.0872 2.1624	3.5335 - 4.0436 .4306
4 4 4	0 - 4.0502 0	- 4.0502 0 3.6543	- 4.0502 0 3.6543	0 0 3.6543

4 4 2	- 1.2958 - 2.7222 - 3.1239	- 5.4219 2.5917 5.0590	- 2.7222 1.5620 2.5220	- 1.2958 1.5620 2.5220
4 4 0	- 1.9599 0 - 4.6329	- 6.1074 3.9199 5.7599	0 2.3165 0	- 1.9599 2.3165 0
4 2 2	- 3.9957 - 2.0603 - 2.2566	- 4.1091 1.9978 3.9225	- 4.1091 4.5133 3.9225	1.9978 - 2.2566 1.9575
4 2 0	- 5.6397 0 - 4.4626	- 4.9437 4.0254 4.7617	0 6.2428 0	1.6143 - 1.7802 0
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3 3 1	- 1.6975 - 1.9564 - 3.7485	- 5.8606 3.3950 5.6536	- 1.9564 1.8742 1.8826	- 1.6975 1.8742 1.8826
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