Nearly Kirkman Triple Systems of Order 18

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Abstract

We obtain 135 nonisomorphic nearly Kirkman triple systems of order 18 (the smallest order for which such a system exists), including all 119 systems of a well-defined subclass.

1 Introduction

Nearly Kirkman triple systems (NKTS) were introduced in [7] as an analogue of Kirkman triple systems (cf. Chapter 19 of [5]). An NKTS of order $v = 6n$ is a partition of the edges of the cocktail-party graph $K_{6n} - F$ into $3n - 1$ (edge-disjoint) triangle-factors. Equivalently, an NKTS(6n) is a resolvable maximum partial triple system (MPT) of order $6n$, or a resolvable 3-GDD of type 2^{3n} (cf. [4], [5]). The existence problem for NKTS was settled in a series of papers [7], [1], [3], [9]: an NKTS(6n) exists if and only if $n \geq 3$.

Thus the smallest order for which an NKTS exists is 18. An example of an NKTS(18) was given in [7] (cf. also [5]). As far as we are able to tell, this is, up to an isomorphism, the only example of an NKTS(18) appearing in the literature thus far.

In this article, we make the first step towards a complete enumeration of NKTS(18). We introduce a classification of NKTS based on invariants discussed in [6] (see also Section 2 below), and obtain a complete enumeration of NKTS(18) of one – well-defined – subclass. On the other hand, we also show that there exist further examples of NKTS(18) not belonging to this subclass.

We were motivated in part by our ultimate goal to achieve a complete enumeration of Kirkman triple systems of order 21 (of which so far 192 nonisomorphic systems are known, cf. [6]) in the hope that an approach similar to that used here might be fruitful for that end.

2 Classification of NKTS by type vectors

Thus an NKTS($6n$) $(V, \mathcal{R}), \mathcal{R} = \{R_1, \ldots, R_{3n-1}, F\}$ consists of $3n - 1$ (edge-) disjoint parallel classes $R_1, \ldots, R_{3n-1}$ of triples (sometimes referred to as *triangle-factors*), and one parallel class F of pairs (the *1-factor*).

Given two distinct parallel classes R, R' in an NKTS($6n$), the *block-intersection graph* $G(R, R')$ has as its vertices all triples of $R \cup R'$; two vertices are adjacent if the corresponding two triples have a common element. Thus $G(R, R')$ is a cubic bipartite graph with $4n$ vertices and $6n$ edges.

The type vector and type matrix are invariants which have been used successfully to distinguish Kirkman triple systems (see, e.g., [10], [8], [6]). They can be used, essentially without changes, to distinguish between nearly Kirkman triple systems.

Let $C_1, \ldots, C_m$ be the list of all nonisomorphic cubic graphs with $4n$ vertices. With any NKTS($6n$), $(V, \mathcal{R})$ where $\mathcal{R} = \{R_1, \ldots, R_{3n-1}, F\}$, associate the *type matrix* $B = (b_{ij})$ of order $3n - 1$ where $b_{ii} = 0$, and for $i \neq j, b_{ij} = k$ if $G(R_i, R_j) \simeq C_k$, and the *type vector* $T = (t_1, \ldots, t_m)$ where $t_k = |\{b_{ij} : i < j, b_{ij} = k\}|$ (cf.[6]).

In this paper, we concentrate on the case of NKTS(18). Any NKTS(18) contains 8 parallel classes of triples. Thus the type matrix is a (symmetric) 8×8 matrix whose entries are from the set $\{1, 2, 3, 4, 5, 6\}$, as there are exactly 6 nonisomorphic cubic bipartite graphs with 12 vertices. One of the graphs is disconnected, the other five are connected (cf. Nos. 64, 66, 71, 74 and 83 in the listing of all 85 connected cubic graphs in [2]). The six nonisomorphic cubic graphs with 12 vertices are listed for convenience below.

GraphNo.	*Vertices*					
	1	2	3	4	5	6
1	*ABC*	*ABC*	*ABC*	*DEF*	*DEF*	*DEF*
2	*ABC*	*ABC*	*ABD*	*CEF*	*DEF*	*DEF*
3	*ABC*	*ABC*	*ADE*	*BDF*	*CEF*	*DEF*
4	*ABC*	*ABD*	*ACE*	*BDF*	*CEF*	*DEF*
5	*ABC*	*ABD*	*ACE*	*BEF*	*CDF*	*DEF*
6	*ABC*	*ABD*	*AEF*	*BEF*	*CDE*	*CDF*

Table 1. The six 12-vertex bipartite cubic graphs

Each graph contains 6 white vertices 1,2,3,4,5,6, and 6 black vertices A,B,C,D,E,F. E.g., in the graph No.1, the white vertex 1 is adjacent to the black vertices A,B, and C, while in the graph No.4, the white vertex 3 is adjacent to the black vertices A,D, and E, etc.

For example, in this notation, the type matrix of the NKTS(18) given in [7] or [5] is

$$\begin{pmatrix} 0 & 1 & 1 & 1 & 6 & 6 & 1 & 6 \\ 1 & 0 & 6 & 6 & 1 & 1 & 6 & 1 \\ 1 & 6 & 0 & 4 & 4 & 4 & 4 & 4 \\ 1 & 6 & 4 & 0 & 4 & 4 & 4 & 4 \\ 6 & 1 & 4 & 4 & 0 & 4 & 4 & 4 \\ 6 & 1 & 4 & 4 & 4 & 0 & 4 & 4 \\ 1 & 6 & 4 & 4 & 4 & 4 & 0 & 4 \\ 6 & 1 & 4 & 4 & 4 & 4 & 4 & 0 \end{pmatrix}$$

and its type vector is $(7, 0, 0, 15, 0, 6)$.

Here type 1 corresponds to the unique disconnected cubic bipartite graph on 12 vertices. In the next section we describe how we generated all NKTS(18) containing at least one pair (of parallel classes R, R' whose block-intersection graph $G(R, R')$ is) of type 1.

3 All NKTS(18) containing type 1 graph

Suppose $(V, \mathcal{R}), \mathcal{R} = \{R_1, R_2, \ldots, R_8, F\}$, is an NKTS(18) such that the intersection graph $G(R_1, R_2)$ is of type 1. Without loss of generality, we may assume $V = \{0, 1, 2, \ldots, 17\}$, and

$R_1 = \{0\ 1\ 2, 3\ 4\ 5, 6\ 7\ 8, 9\ a\ b, c\ d\ e, f\ g\ h\}$,
$R_2 = \{0\ 3\ 6, 1\ 4\ 7, 2\ 5\ 8, 9\ c\ f, a\ d\ g, b\ e\ h\}$.

Then we have:

Lemma 1 *Each edge of F joins a vertex of $V_1 = \{0, 1, 2, 3, 4, 5, 6, 7, 8\}$ to a vertex of $V_2 = \{9, a, b, c, d, e, f, g, h\}$.*

Proof. $(V, \mathcal{R})$ contains 36 triples in addition to those of $R_1 \cup R_2$. There are 81 pairs $\{x, y\}$ with $x \in V_1, y \in V_2$. Each triple covering such a pair covers exactly two such pairs and contains two elements from V_1 and one from V_2, or vice versa; it also covers one pair $\{u, v\}$ with both $u, v \in V_i, i \in \{1, 2\}$. There are exactly 36 pairs of the latter kind to be covered by the 36 triples, and the statement of the lemma now follows easily. Λ

Thus the 1-factor F is of the form

$F = \{\{x_i, y_i\} : x_i \in V_1, y_i \in V_2\}$.

In order to generate all NKTS(18) containing at least one pair of parallel classes of type 1, we first established that there are exactly 65 nonisomorphic possibilities for the 1-factor F (provided R_1, R_2 are fixed as above). For example, some of these are

$F_0 = \{0\ 9, 1\ a, 2\ b, 3\ c, 4\ d, 5\ e, 6\ f, 7\ g, 8\ h\}$
$F_1 = \{0\ 9, 1\ a, 2\ b, 3\ c, 4\ d, 5\ e, 6\ f, 7\ h, 8\ g\}$
$\cdots\cdots$
$F_{26} = \{0\ 9, 1\ a, 2\ b, 3\ d, 4\ e, 5\ c, 6\ h, 7\ f, 8\ g\}$
$\cdots\cdots$
$F_{64} = \{0\ 9, 1\ d, 2\ h, 3\ e, 4\ f, 5\ a, 6\ g, 7\ b, 8\ c\}$.

[A full listing of the 65 possible 1-factors can be found in the Appendix.]

Next, given the triples of $R_1 \cup R_2$ and a particular 1-factor F_i, all possible completions to an MPT(18) were generated by an exhaustive backtrack. This always resulted in a huge number of MPT(18): on average, over 2 million MPTs were obtained for a given F_i, from 1,749,092 for F_{53}, to 3,408,192 for F_{64}. Each obtained MPT(18) was then analyzed for resolvability, and all NKTS(18) obtained were recorded. For each of F_0 and F_{64}, 17 nonisomorphic NKTS(18) were generated while for 34 of the 65 possible 1-factors (e.g, for F_1 shown above), none of the obtained MPT(18) was resolvable, and thus yielded no NKTS.

The total number of nonisomorphic NKTS(18) that we obtained is 135. However, not all of the obtained solutions contain a a pair of parallel classes of type 1. This is due to the fact that even though we always started with such a pair, the completions to MPT(18) that were generated were only then tested for resolvability in all possible ways. In some solutions, the original pair of parallel classes gets "destroyed". Altogether, among the 135 solutions obtained, there are 16 that have this property. One of these solutions has the following 8 parallel classes:

$\{0\ 7\ g, 1\ 3\ b, 2\ a\ h, 4\ 6\ c, 5\ 9\ e, 8\ d\ f\}$
$\{0\ 5\ f, 1\ 6\ g, 2\ 4\ d, 3\ 9\ h, 7\ a\ e, 8\ b\ c\}$
$\{0\ a\ c, 1\ 5\ d, 2\ 3\ f, 4\ 9\ g, 6\ 7\ 8, b\ e\ h\}$
$\{0\ d\ h, 1\ 8\ 9, 2\ 6\ e, 3\ 7\ c, 4\ a\ f, 5\ b\ g\}$
$\{0\ 8\ e, 1\ c\ h, 2\ 7\ 9, 6\ b\ f, 3\ 4\ 5, a\ d\ g\}$
$\{0\ 4\ b, 1\ e\ f, 2\ c\ g, 3\ 8\ a, 5\ 7\ h, 6\ 9\ d\}$
$\{0\ 1\ 2, 3\ e\ g, 4\ 8\ h, 5\ 6\ a, 7\ b\ d, 9\ c\ f\}$
$\{0\ 3\ 6, 1\ 4\ 7, 2\ 5\ 8, 9\ a\ b, c\ d\ e, f\ g\ h\}$.

Its type vector is $(0, 0, 10, 3, 15, 0)$.

On the other hand, it is clear that all solutions containing at least one pair of parallel classes of type 1 are among the 135 solutions generated. Thus we get:

Theorem 1 *There are exactly 119 nonisomorphic NKTS(18) containing at least one pair of parallel classes of type 1.*

Of the 119 solutions, the first component of the type vector equals 1 in 111 cases, equals 2 in 5 cases, 4 in 2 cases, and 7 in a single case; the latter corresponds to the solution given originally in [7].

A complete list of the 119 solutions, with their type vectors, automorphism group orders, and their number of 5- and 6-cocliques is given in the Appendix.

The type vectors proved to be very efficient invariants: they alone distinguish the 119 solutions with type 1 pair of parallel classes, except between pair of solutions in four cases, and between one quadruple of solutions. However, employing, in addition, the type matrix further distinguishes all solutions except of one single triple of solutions!

In addition to type vectors and type matrices, we also calculated, for each obtained solution, the number of sets of 5 (or 6, respectively) disjoint triples, each from a different parallel class (i.e., "transversal" sets of 5 or 6 triples). These distinguish the remaining solutions.

As can be seen from the list of type vectors corresponding to the individual solutions, in almost half of all cases (59) the type vectors have no zero component, and thus the corresponding NKTS contain at least one pair of parallel classes of each of the six possible types. In analogy with [6], these can be termed type-heterogeneous. On the other hand, the minimum number of nonzero components in the type vector of any obtained solution is 3 (there are three such solutions, including the one given above) which does not come even close to a type-uniform solution (cf. [6]).

4 Conclusion

Among the 16 solutions obtained that do not contain a pair of parallel classes of type 1, there are 12 that do not contain a pair of type 2 either, including one (the solution given above) which does not contain a pair of type 6, either. It is reasonable to expect further, yet unobtained, solutions to exist. It appears, however, that the approach and methods of this paper need to be extended and refined before a complete enumeration of NKTS(18) can be successfully performed.

5 Acknowledgement

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6 APPENDIX

The 65 non-isomorphic 1-factors for type 1 pair of parallel classes

```
09 1a 2b 3c 4d 5e 6f 7g 8h    09 1a 2b 3c 4d 5e 6f 7h 8g    09 1a 2b 3c 4d 5e 6g 7h 8f
09 1a 2b 3c 4d 5f 6e 7g 8h    09 1a 2b 3c 4d 5f 6e 7h 8g    09 1a 2b 3c 4d 5f 6g 7e 8h
09 1a 2b 3c 4d 5f 6g 7h 8e    09 1a 2b 3c 4d 5f 6h 7e 8g    09 1a 2b 3c 4d 5f 6h 7g 8e
09 1a 2b 3c 4e 5d 6g 7f 8h    09 1a 2b 3c 4e 5d 6g 7h 8f    09 1a 2b 3c 4e 5f 6d 7h 8g
09 1a 2b 3c 4e 5f 6g 7d 8h    09 1a 2b 3c 4e 5f 6g 7h 8d    09 1a 2b 3c 4e 5f 6h 7d 8g
09 1a 2b 3c 4e 5f 6h 7g 8d    09 1a 2b 3c 4e 5g 6h 7d 8f    09 1a 2b 3c 4e 5g 6h 7f 8d
09 1a 2b 3c 4e 5h 6f 7d 8g    09 1a 2b 3c 4e 5h 6g 7d 8f    09 1a 2b 3c 4f 5g 6d 7e 8h
09 1a 2b 3c 4f 5g 6e 7h 8d    09 1a 2b 3c 4f 5g 6h 7e 8d    09 1a 2b 3c 4h 5g 6f 7e 8d
09 1a 2b 3d 4c 5f 6e 7h 8g    09 1a 2b 3d 4c 5f 6h 7e 8g    09 1a 2b 3d 4e 5c 6h 7f 8g
09 1a 2b 3d 4e 5f 6g 7h 8c    09 1a 2b 3d 4e 5f 6h 7c 8g    09 1a 2c 3b 4d 5f 6e 7h 8g
09 1a 2c 3b 4d 5f 6g 7h 8e    09 1a 2c 3b 4d 5f 6h 7e 8g    09 1a 2c 3b 4d 5f 6h 7e 8g
09 1a 2c 3b 4d 5g 6f 7e 8h    09 1a 2c 3b 4d 5g 6f 7h 8e    09 1a 2c 3b 4d 5g 6h 7e 8f
09 1a 2c 3b 4d 5g 6h 7f 8e    09 1a 2c 3b 4d 5h 6g 7f 8e    09 1a 2c 3b 4e 5f 6d 7g 8h
09 1a 2c 3b 4e 5f 6g 7d 8h    09 1a 2c 3b 4e 5f 6g 7h 8d    09 1a 2c 3b 4e 5f 6h 7d 8g
09 1a 2c 3b 4e 5f 6h 7g 8d    09 1a 2c 3b 4e 5g 6d 7f 8h    09 1a 2c 3b 4e 5g 6d 7h 8f
09 1a 2c 3b 4e 5g 6h 7d 8f    09 1a 2c 3b 4f 5e 6d 7h 8g    09 1a 2c 3b 4f 5e 6g 7d 8h
09 1a 2c 3b 4f 5e 6h 7d 8g    09 1a 2c 3b 4f 5g 6d 7e 8h    09 1a 2c 3b 4f 5g 6d 7h 8e
09 1a 2c 3b 4g 5f 6h 7d 8e    09 1a 2c 3b 4g 5f 6h 7e 8d    09 1a 2c 3b 4h 5f 6e 7g 8d
09 1a 2c 3d 4b 5f 6h 7e 8g    09 1a 2c 3d 4b 5g 6h 7f 8e    09 1a 2c 3d 4b 5h 6g 7f 8e
09 1a 2c 3d 4e 5g 6h 7f 8b    09 1a 2c 3d 4e 5h 6g 7f 8b    09 1a 2c 3d 4f 5b 6h 7e 8g
09 1a 2c 3d 4f 5e 6h 7b 8g    09 1a 2c 3d 4f 5h 6e 7g 8b    09 1a 2c 3d 4f 5h 6g 7e 8b
09 1a 2e 3d 4f 5b 6h 7c 8g    09 1d 2h 3e 4f 5a 6g 7b 8c
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The 119 non-isomorphic NKTS(18) with at least one type 1 pair of parallel classes

1: 0ef 1bg 27a 3dh 48c 569   04b 13f 29d 57h 6ac 8eg   05g 1ch 24f 38a 6bd 79e   012 345 678 9cf adg beh
   07c 15d 26h 39g 4ae 8bf   08d 16e 2cg 37b 49h 5af   0ah 189 23e 46g 5bc 7df   036 147 258 9ab cde fgh

2: 04b 13f 29d 57h 6ac 8eg   05g 1ch 24f 38a 6bd 79e   012 345 678 9cf adg beh   07c 15d 26h 39g 4ae 8bf
   08d 16e 2cg 37b 49h 5af   0ef 189 27a 3dh 46g 5bc   0ah 1bg 23e 48c 569 7df   036 147 258 9ab cde fgh

3: 0ef 1bg 27a 3dh 48c 569   04b 13f 29d 57h 6ac 8eg   05g 1ch 24f 38a 6bd 79e   07c 15d 26h 39g 4ae 8bf
   012 345 678 9ab cde fgh   08d 16e 2cg 37b 49h 5af   0ah 189 23e 46g 5bc 7df   036 147 258 9cf adg beh

4: 04b 13f 29d 57h 6ac 8eg   05g 1ch 24f 38a 6bd 79e   07c 15d 26h 39g 4ae 8bf   012 345 678 9ab cde fgh
   08d 16e 2cg 37b 49h 5af   0ef 189 27a 3dh 46g 5bc   0ah 1bg 23e 48c 569 7df   036 147 258 9cf adg beh

5: 0ac 1df 24g 38b 56h 79e   012 345 678 9cf adg beh   036 147 258 9ab cde fgh   07h 189 26d 3ae 4bf 5cg
   05f 1ch 239 46a 7bd 8eg   0bg 16e 2ah 37f 48c 59d   04e 15b 27c 3dh 69g 8af   08d 13g 2ef 49h 57a 6bc

6: 0ac 1df 24g 38b 56h 79e   012 345 678 9ab cde fgh   036 147 258 9cf adg beh   07h 189 26d 3ae 4bf 5cg
   05f 1ch 239 46a 7bd 8eg   0bg 16e 2ah 37f 48c 59d   04e 15b 27c 3dh 69g 8af   08d 13g 2ef 49h 57a 6bc

7: 08d 13g 2ch 4bf 57a 69e   0ac 1ef 24g 38b 56h 79d   0bg 15c 26d 37e 49h 8af   05f 1dh 239 46a 7bc 8eg
   07h 16b 2ae 3df 48c 59g   012 345 678 9cf adg beh   036 147 258 9ab cde fgh   04e 189 27f 3ah 5bd 6cg

8: 08d 13g 2ch 4bf 57a 69e   0ac 1ef 24g 38b 56h 79d   0bg 15c 26d 37e 49h 8af   036 147 258 9cf adg beh
   05f 1dh 239 46a 7bc 8eg   07h 16b 2ae 3df 48c 59g   012 345 678 9ab cde fgh   04e 189 27f 3ah 5bd 6cg

9: 07h 1df 2ae 39g 48c 56b   0bg 13e 26d 49h 57c 8af   0ac 16h 24g 38b 59d 7ef   036 147 258 9cf adg beh
   012 345 678 9ab cde fgh   04e 189 23f 5ah 6cg 7bd   08d 15g 2ch 37a 4bf 69e   05f 1bc 279 3dh 46a 8eg

10: 07h 1df 2ae 39g 48c 56b   0bg 13e 26d 49h 57c 8af   0ac 16h 24g 38b 59d 7ef   012 345 678 9cf adg beh
    036 147 258 9ab cde fgh   04e 189 23f 5ah 6cg 7bd   08d 15g 2ch 37a 4bf 69e   05f 1bc 279 3dh 46a 8eg

11: 05g 13h 24f 6bd 79e 8ac   08d 16e 27c 3bg 49h 5af   0ef 1cg 2dh 37a 48b 569   036 147 258 9cf adg beh
    0ah 189 23e 46g 5bc 7df   07b 15d 29g 38f 4ae 6ch   012 345 678 9ab cde fgh   04c 1bf 26a 39d 57h 8eg

12: 05g 13h 24f 6bd 79e 8ac   0ef 1cg 2dh 37a 48b 569   036 147 258 9cf adg beh   08d 16e 27c 345 9ab fgh
    0ah 189 23e 46g 5bc 7df   07b 15d 29g 38f 4ae 6ch   012 678 cde 3bg 49h 5af   04c 1bf 26a 39d 57h 8eg

13: 05g 13h 24f 6bd 79e 8ac   08d 16e 27c 3bg 49h 5af   0ef 1cg 2dh 345 678 9ab   036 147 258 9cf adg beh
    0ah 189 23e 46g 5bc 7df   07b 15d 29g 38f 4ae 6ch   012 cde fgh 37a 48b 569   04c 1bf 26a 39d 57h 8eg

14: 05g 13h 24f 6bd 79e 8ac   04c 1bf 2dh 37a 569 8eg   036 147 258 9cf adg beh   08d 16e 27c 345 9ab fgh
    0ah 189 23e 46g 5bc 7df   07b 15d 29g 38f 4ae 6ch   012 678 cde 3bg 49h 5af   0ef 1cg 26a 39d 48b 57h

15: 05g 13h 24f 6bd 79e 8ac   08d 16e 27c 3bg 49h 5af   0ef 189 2dh 37a 46g 5bc   036 147 258 9cf adg beh
    0ah 1cg 23e 48b 569 7df   07b 15d 29g 38f 4ae 6ch   012 345 678 9ab cde fgh   04c 1bf 26a 39d 57h 8eg

16: 07b 13e 29g 48f 5ac 6dh   012 345 678 9ab cde fgh   036 147 258 9cf adg beh   08c 1df 27e 39h 46a 5bg
    05d 16b 2af 38g 49e 7ch   0ef 1cg 24h 37a 569 8bd   04g 15h 26c 3bf 79d 8ae   0ah 189 23d 4bc 57f 6eg

17: 07b 13e 29g 48f 5ac 6dh   012 345 678 9cf adg beh   036 147 258 9ab cde fgh   08c 1df 27e 39h 46a 5bg
    05d 16b 2af 38g 49e 7ch   0ef 1cg 24h 37a 569 8bd   04g 15h 26c 3bf 79d 8ae   0ah 189 23d 4bc 57f 6eg

18: 012 345 678 9ab cde fgh   05h 1ef 26c 38a 49g 7bd   07e 189 23g 4ah 5bc 6df   08d 13b 24f 5eg 69h 7ac
    036 147 258 9cf adg beh   04c 16g 2ae 3dh 579 8bf   0af 15d 27h 39e 46b 8cg   0bg 1ch 29d 37f 48e 56a

19: 05h 1ef 26c 38a 49g 7bd   07e 189 23g 4ah 5bc 6df   08d 13b 24f 5eg 69h 7ac   012 345 678 9cf adg beh
    04c 16g 2ae 3dh 579 8bf   036 147 258 9ab cde fgh   0af 15d 27h 39e 46b 8cg   0bg 1ch 29d 37f 48e 56a

20: 012 345 678 9ab cde fgh   0af 15d 26c 37h 49e 8bg   08e 13b 2dh 46f 59g 7ac   036 147 258 9cf adg beh
    0cg 189 23f 4ah 57e 6bd   05h 16g 2ae 39d 48c 7bf   04b 1ch 279 3eg 56a 8df   07d 1ef 24g 38a 5bc 69h

21: 0af 15d 26c 37h 49e 8bg   08e 13b 2dh 46f 59g 7ac   012 345 678 9cf adg beh   0cg 189 23f 4ah 57e 6bd
    036 147 258 9ab cde fgh   05h 16g 2ae 39d 48c 7bf   04b 1ch 279 3eg 56a 8df   07d 1ef 24g 38a 5bc 69h

22: 012 345 678 9ab cde fgh   08d 19e 26g 37a 4bf 5ch   04h 16f 23e 59g 7bd 8ac   0af 13h 29d 48g 57e 6bc
    036 147 258 9cf adg beh   0eg 18b 24c 3df 56a 79h   05b 1cg 27f 389 4ae 6dh   07c 15d 2ah 3bg 469 8ef

23: 08d 19e 26g 37a 4bf 5ch   04h 16f 23e 59g 7bd 8ac   0af 13h 29d 48g 57e 6bc   012 345 678 9cf adg beh
    036 147 258 9ab cde fgh   0eg 18b 24c 3df 56a 79h   05b 1cg 27f 389 4ae 6dh   07c 15d 2ah 3bg 469 8ef

24: 012 345 678 9ab cde fgh   04h 1bf 27c 38g 59d 6ae   036 147 258 9cf adg beh   0af 16d 2eg 39h 48c 57b
    0cg 189 24a 3bd 56h 7ef   07d 15g 23f 49e 6bc 8ah   08b 13e 2dh 46f 5ac 79g   05e 1ch 269 37a 4bg 8df

25: 04h 1bf 27c 38g 59d 6ae   012 345 678 9cf adg beh   0af 16d 2eg 39h 48c 57b   036 147 258 9ab cde fgh
    0cg 189 24a 3bd 56h 7ef   07d 15g 23f 49e 6bc 8ah   08b 13e 2dh 46f 5ac 79g   05e 1ch 269 37a 4bg 8df

26: 0af 18g 23h 49e 57c 6bd   07b 13e 24f 59g 6ac 8dh   012 345 678 9cf adg beh   08c 15b 2ae 3df 46g 79h
    0eg 16f 27d 389 4bc 5ah   036 147 258 9ab cde fgh   05d 1ch 269 3bg 48a 7ef   04h 19d 2cg 37a 56e 8bf

27: 012 345 678 9ab cde fgh   0af 18g 23h 49e 57c 6bd   07b 13e 24f 59g 6ac 8dh   036 147 258 9cf adg beh
    08c 15b 2ae 3df 46g 79h   0eg 16f 27d 389 4bc 5ah   05d 1ch 269 3bg 48a 7ef   04h 19d 2cg 37a 56e 8bf

28: 012 345 678 9ab cde fgh   0ch 1ef 26g 389 4bd 57a   07e 1bg 23d 48f 59h 6ac   036 147 258 9cf adg beh
    0df 18c 2ah 37b 49g 56e   05g 13h 24c 6bf 79d 8ae   08b 15d 29e 3af 46h 7cg   04a 169 27f 3eg 5bc 8dh

29: 0ch 1ef 26g 389 4bd 57a   07e 1bg 23d 48f 59h 6ac   012 345 678 9cf adg beh   0df 18c 2ah 37b 49g 56e
    036 147 258 9ab cde fgh   05g 13h 24c 6bf 79d 8ae   08b 15d 29e 3af 46h 7cg   04a 169 27f 3eg 5bc 8dh

30: 012 345 678 9ab cde fgh   08b 15e 269 3ah 4df 7cg   07f 1bd 2ac 38e 46g 59h   0ch 13f 27d 489 5bg 6ae
    036 147 258 9cf adg beh   05d 16h 23g 4bc 79e 8af   04a 19g 2ef 37b 56c 8dh   0eg 18c 24h 39d 57a 6bf

31: 08b 15e 269 3ah 4df 7cg   07f 1bd 2ac 38e 46g 59h   0ch 13f 27d 489 5bg 6ae   012 345 678 9cf adg beh
    036 147 258 9ab cde fgh   05d 16h 23g 4bc 79e 8af   04a 19g 2ef 37b 56c 8dh   0eg 18c 24h 39d 57a 6bf

32: 08b 15e 29h 37g 4df 6ac   036 147 258 9ab cde fgh   07a 1dh 23f 4bc 569 8eg   0ch 16f 27d 3ae 489 5bg
    012 345 678 9cf adg beh   04g 18c 26e 39d 5ah 7bf   05d 13b 2cg 46h 79e 8af   0ef 19g 24a 38h 57c 6bd

33: 08b 15e 29h 37g 4df 6ac   012 345 678 9ab cde fgh   07a 1dh 23f 4bc 569 8eg   0ch 16f 27d 3ae 489 5bg
    036 147 258 9cf adg beh   04g 18c 26e 39d 5ah 7bf   05d 13b 2cg 46h 79e 8af   0ef 19g 24a 38h 57c 6bd

34: 012 345 678 9ab cde fgh   08a 15b 26c 39g 4dh 7ef   0bg 16h 2df 38e 4ac 579   04f 18c 27g 3bd 5ah 69e

86

036 147 258 9cf adg beh   07d 13f 2ae 46b 5cg 89h   0ch 1eg 249 37a 56d 8bf   05e 19d 23h 48g 6af 7bc

35: 08a 15b 26c 39g 4dh 7ef   0bg 16h 2df 38e 4ac 579   04f 18c 27g 3bd 5ah 69e   012 345 678 9cf adg beh
036 147 258 9ab cde fgh   07d 13f 2ae 46b 5cg 89h   0ch 1eg 249 37a 56d 8bf   05e 19d 23h 48g 6af 7bc

36: 012 345 678 9ab cde fgh   05c 18d 23g 4bf 6ae 79h   07a 139 2dh 4cg 56b 8ef   036 147 258 9cf adg beh
0eg 16f 24a 38h 59d 7bc   08b 1ch 29e 3af 46d 57g   04h 15e 27f 3bd 69g 8ac   0df 1bg 26c 37e 489 5ah

37: 036 147 258 9ab cde fgh   05c 18d 23g 4bf 6ae 79h   07a 139 2dh 4cg 56b 8ef   012 345 678 9cf adg beh
0eg 16f 24a 38h 59d 7bc   08b 1ch 29e 3af 46d 57g   04h 15e 27f 3bd 69g 8ac   0df 1bg 26c 37e 489 5ah

38: 08h 16d 23e 49g 5bc 7af   0bd 1ch 24a 38f 56g 79e   012 345 678 9cf adg beh   07c 13g 2df 46b 59h 8ae
05a 189 2cg 37b 4dh 6ef   036 147 258 9ab cde fgh   0eg 1bf 269 3ah 48c 57d   04f 15e 27h 39d 6ac 8bg

39: 012 345 678 9ab cde fgh   08h 16d 23e 49g 5bc 7af   0bd 1ch 24a 38f 56g 79e   036 147 258 9cf adg beh
07c 13g 2df 46b 59h 8ae   05a 189 2cg 37b 4dh 6ef   0eg 1bf 269 3ah 48c 57d   04f 15e 27h 39d 6ac 8bg

40: 07b 16g 2ch 389 4df 5ae   012 345 678 9ab cde fgh   0af 18e 26d 3bg 49h 57c   036 147 258 9cf adg beh
05d 13f 29e 46b 7ah 8cg   0eg 1bc 27f 3dh 48a 569   08h 19d 24g 37e 5bf 6ac   04c 15h 23a 6ef 79g 8bd

41: 07b 16g 2ch 389 4df 5ae   036 147 258 9ab cde fgh   0af 18e 26d 3bg 49h 57c   012 345 678 9cf adg beh
05d 13f 29e 46b 7ah 8cg   0eg 1bc 27f 3dh 48a 569   08h 19d 24g 37e 5bf 6ac   04c 15h 23a 6ef 79g 8bd

42: 07a 13g 26e 4df 59h 8bc   0ch 1bf 23a 48g 56d 79e   04b 15e 2dh 389 6af 7cg   012 345 678 9cf adg beh
08d 16c 29g 3ef 4ah 57b   036 147 258 9ab cde fgh   0eg 18h 27f 3bd 469 5ac   05f 19d 24c 37h 6bg 8ae

43: 012 345 678 9ab cde fgh   07a 13g 26e 4df 59h 8bc   0ch 1bf 23a 48g 56d 79e   04b 15e 2dh 389 6af 7cg
036 147 258 9cf adg beh   08d 16c 29g 3ef 4ah 57b   0eg 18h 27f 3bd 469 5ac   05f 19d 24c 37h 6bg 8ae

44: 012 345 678 9ab cde fgh   0dh 16b 23a 489 5ef 7cg   07b 15g 2df 38e 4ac 69h   036 147 258 9cf adg beh
08c 19e 24h 3bg 56d 7af   0eg 13f 26c 4bd 579 8ah   04f 18d 29g 37h 5bc 6ae   05a 1ch 27e 39d 46g 8bf

45: 0dh 16b 23a 489 5ef 7cg   07b 15g 2df 38e 4ac 69h   012 345 678 9cf adg beh   08c 19e 24h 3bg 56d 7af
0eg 13f 26c 4bd 579 8ah   036 147 258 9ab cde fgh   04f 18d 29g 37h 5bc 6ae   05a 1ch 27e 39d 46g 8bf

46: 08c 13h 29e 46a 5df 7bg   012 345 678 9ab cde fgh   0dh 1bf 2ac 37e 489 56g   0eg 18d 24h 3af 579 6bc
036 147 258 9cf adg beh   04f 19g 26d 38b 5ae 7ch   07a 15c 23g 4bd 69h 8ef   05b 16e 27f 39d 4cg 8ah

47: 08c 13h 29e 46a 5df 7bg   036 147 258 9ab cde fgh   0dh 1bf 2ac 37e 489 56g   0eg 18d 24h 3af 579 6bc
012 345 678 9cf adg beh   04f 19g 26d 38b 5ae 7ch   07a 15c 23g 4bd 69h 8ef   05b 16e 27f 39d 4cg 8ah

48: 05d 18e 29h 37f 4ac 6bg   036 147 258 9ab cde fgh   08g 13b 2df 49e 57c 6ah   0ch 16f 24g 389 5ae 7bd
012 345 678 9cf adg beh   07a 19d 26c 3eg 48h 5bf   04b 1cg 27e 3dh 569 8af   0ef 15h 23a 46d 79g 8bc

49: 05d 18e 29h 37f 4ac 6bg   012 345 678 9ab cde fgh   08g 13b 2df 49e 57c 6ah   0ch 16f 24g 389 5ae 7bd
036 147 258 9cf adg beh   07a 19d 26c 3eg 48h 5bf   04b 1cg 27e 3dh 569 8af   0ef 15h 23a 46d 79g 8bc

50: 012 345 678 9ab cde fgh   04a 1df 29e 38g 56h 7bc   05c 18h 27g 3ae 4bf 69d   0eg 16c 23f 489 5bd 7ah
08b 19g 2ch 37d 46e 5af   036 147 258 9cf adg beh   0dh 13b 26a 4cg 579 8ef   07f 15e 24d 39h 6bg 8ac

51: 04a 1df 29e 38g 56h 7bc   05c 18h 27g 3ae 4bf 69d   0eg 16c 23f 489 5bd 7ah   012 345 678 9cf adg beh
08b 19g 2ch 37d 46e 5af   0dh 13b 26a 4cg 579 8ef   036 147 258 9ab cde fgh   07f 15e 24d 39h 6bg 8ac

52: 0eg 13b 26a 489 5ch 7df   012 345 678 9ab cde fgh   07a 18h 2cg 39d 4bf 56e   036 147 258 9cf adg beh
08f 15d 29e 3ah 46g 7bc   0dh 16c 23f 4ae 579 8bg   04c 19g 27h 38e 5af 6bd   05b 1ef 24d 37g 69h 8ac

53: 0eg 13b 26a 489 5ch 7df   036 147 258 9ab cde fgh   07a 18h 2cg 39d 4bf 56e   012 345 678 9cf adg beh
08f 15d 29e 3ah 46g 7bc   0dh 16c 23f 4ae 579 8bg   04c 19g 27h 38e 5af 6bd   05b 1ef 24d 37g 69h 8ac

54: 036 147 258 9ab cde fgh   0dh 13b 26a 489 5ef 7cg   04c 16e 27f 39d 5ah 8bg   0eg 18h 24d 3af 579 6bc
05b 1df 29e 37h 46g 8ac   012 345 678 9cf adg beh   08f 15c 23g 4ae 69h 7bd   07a 19g 2ch 38e 4bf 56d

55: 0dh 13b 26a 489 5ef 7cg   04c 16e 27f 39d 5ah 8bg   036 147 258 9cf adg beh   0eg 18h 24d 3af 579 6bc
05b 1df 29e 37h 46g 8ac   012 345 678 9ab cde fgh   08f 15c 23g 4ae 69h 7bd   07a 19g 2ch 38e 4bf 56d

56: 04g 1bd 26h 37f 5ac 89e   08h 15f 27c 3bg 49d 6ae   0bc 18g 239 4ef 56d 7ah   0af 169 2eg 3dh 48c 57b
05e 1ch 2df 38a 46b 79g   012 345 678 9cf adg beh   07d 13e 24a 59h 6cg 8bf   036 147 258 9ab cde fgh

87

57: 04g 1bd 26h 37f 5ac 89e   08h 15f 27c 3bg 49d 6ae   0bc 18g 239 4ef 56d 7ah   0af 169 2eg 3dh 48c 57b
    05e 1ch 2df 38a 46b 79g   012 345 678 9ab cde fgh   036 147 258 9cf adg beh   07d 13e 24a 59h 6cg 8bf

58: 07b 13e 2af 46g 59d 8ch   0ah 189 24d 3bc 57g 6ef   036 147 258 9cf adg beh   04f 15h 27c 39g 6bd 8ae
    08d 16c 2eg 37a 49h 5bf   0cg 1df 23h 48b 56a 79e   012 345 678 9ab cde fgh   05e 1bg 269 38f 4ac 7dh

59: 07b 13e 2af 46g 59d 8ch   0ah 189 24d 3bc 57g 6ef   036 147 258 9ab cde fgh   04f 15h 27c 39g 6bd 8ae
    08d 16c 2eg 37a 49h 5bf   0cg 1df 23h 48b 56a 79e   012 345 678 9cf adg beh   05e 1bg 269 38f 4ac 7dh

60: 05f 13b 2cg 48h 69d 7ae   07g 15d 26e 39h 4af 8bc   04b 16g 2ah 37c 59e 8df   0ac 189 24d 3eg 57h 6bf
    012 345 678 9cf adg beh   0dh 1ef 279 38a 46c 5bg   08e 1ch 23f 49g 56a 7bd   036 147 258 9ab cde fgh

61: 05f 13b 2cg 48h 69d 7ae   07g 15d 26e 39h 4af 8bc   04b 16g 2ah 37c 59e 8df   0ac 189 24d 3eg 57h 6bf
    012 345 678 9ab cde fgh   0dh 1ef 279 38a 46c 5bg   08e 1ch 23f 49g 56a 7bd   036 147 258 9cf adg beh

62: 08e 13b 2cg 4af 57h 69d   04b 16g 2ah 37c 59e 8df   0dh 189 23f 46c 5bg 7ae   012 345 678 9cf adg beh
    0ac 15d 279 3eg 48h 6bf   05f 1ch 26e 38a 49g 7bd   07g 1ef 24d 39h 56a 8bc   036 147 258 9ab cde fgh

63: 08e 13b 2cg 4af 57h 69d   04b 16g 2ah 37c 59e 8df   0dh 189 23f 46c 5bg 7ae   012 345 678 9ab cde fgh
    0ac 15d 279 3eg 48h 6bf   05f 1ch 26e 38a 49g 7bd   07g 1ef 24d 39h 56a 8bc   036 147 258 9cf adg beh

64: 036 147 258 9cf adg beh   0df 13e 26b 4ah 579 8cg   05h 1bg 29d 37c 46f 8ae   012 345 678 9ab cde fgh
    08b 15c 24g 3af 69e 7dh   07g 19h 2ef 38d 4bc 56a   04e 18f 27a 39g 5bd 6ch   0ac 16d 23h 489 5eg 7bf

65: 036 147 258 9ab cde fgh   0df 13e 26b 4ah 579 8cg   05h 1bg 29d 37c 46f 8ae   012 345 678 9cf adg beh
    08b 15c 24g 3af 69e 7dh   07g 19h 2ef 38d 4bc 56a   04e 18f 27a 39g 5bd 6ch   0ac 16d 23h 489 5eg 7bf

66: 04c 16b 29g 37e 5af 8dh   036 147 258 9ab cde fgh   05h 18f 26d 3ac 49e 7bg   07d 13g 2ef 4ah 569 8bc
    08a 15e 24b 3df 6cg 79h   0bf 19d 23h 48g 57c 6ae   012 345 678 9cf adg beh   0eg 1ch 27a 389 46f 5bd

67: 04c 16b 29g 37e 5af 8dh   012 345 678 9ab cde fgh   05h 18f 26d 3ac 49e 7bg   07d 13g 2ef 4ah 569 8bc
    08a 15e 24b 3df 6cg 79h   0bf 19d 23h 48g 57c 6ae   036 147 258 9cf adg beh   0eg 1ch 27a 389 46f 5bd

68: 0ae 16f 2bg 3ch 489 57d   036 147 258 9ab cde fgh   07h 13e 24f 59g 6bd 8ac   0df 18h 239 4eg 56a 7bc
    012 345 678 9cf adg beh   04b 1cg 27a 38d 5ef 69h   05c 19d 26e 37g 4ah 8bf   08g 15b 2dh 3af 46c 79e

69: 0ae 16f 2bg 3ch 489 57d   012 345 678 9ab cde fgh   07h 13e 24f 59g 6bd 8ac   0df 18h 239 4eg 56a 7bc
    036 147 258 9cf adg beh   04b 1cg 27a 38d 5ef 69h   05c 19d 26e 37g 4ah 8bf   08g 15b 2dh 3af 46c 79e

70: 0ah 15e 26b 379 4df 8cg   07d 1ch 23f 48b 59g 6ae   012 345 678 9cf adg beh   0bf 189 2dh 3eg 46c 57a
    036 147 258 9ab cde fgh   04g 13d 29e 56h 7bc 8af   08e 16f 27g 3ac 49h 5bd   05c 1bg 24a 38h 69d 7ef

71: 012 345 678 9ab cde fgh   0ah 15e 26b 379 4df 8cg   07d 1ch 23f 48b 59g 6ae   036 147 258 9cf adg beh
    0bf 189 2dh 3eg 46c 57a   04g 13d 29e 56h 7bc 8af   08e 16f 27g 3ac 49h 5bd   05c 1bg 24a 38h 69d 7ef

72: 08e 16c 23d 4bg 59h 7af   036 147 258 9ab cde fgh   07g 189 24h 3ef 5ac 6bd   012 345 678 9cf adg beh
    05b 1eg 26f 38a 49d 7ch   0df 13h 29g 46a 57e 8bc   0ah 15d 27b 3cg 48f 69e   04c 1bf 2ae 379 56g 8dh

73: 08e 16c 23d 4bg 59h 7af   012 345 678 9ab cde fgh   07g 189 24h 3ef 5ac 6bd   036 147 258 9cf adg beh
    05b 1eg 26f 38a 49d 7ch   0df 13h 29g 46a 57e 8bc   0ah 15d 27b 3cg 48f 69e   04c 1bf 2ae 379 56g 8dh

74: 05a 169 2dh 37c 4bg 8ef   036 147 258 9ab cde fgh   07d 18b 23f 4ch 59g 6ae   0bc 15h 29e 38g 46d 7af
    012 345 678 9cf adg beh   08h 1cg 24a 39d 57e 6bf   0eg 1df 27b 3ah 489 56c   04f 13e 26g 5bd 79h 8ac

75: 05a 169 2dh 37c 4bg 8ef   012 345 678 9ab cde fgh   07d 18b 23f 4ch 59g 6ae   0bc 15h 29e 38g 46d 7af
    036 147 258 9cf adg beh   08h 1cg 24a 39d 57e 6bf   0eg 1df 27b 3ah 489 56c   04f 13e 26g 5bd 79h 8ac

76: 036 147 258 9ab cde fgh   0bg 18e 23f 4ac 56d 79h   08c 13h 26a 4bd 59g 7ef   0af 15b 2dh 37c 489 6eg
    012 345 678 9cf adg beh   04h 1df 29e 38g 57a 6bc   07d 169 24g 3ae 5ch 8bf   05e 1cg 27b 39d 46f 8ah

77: 012 345 678 9ab cde fgh   0bg 18e 23f 4ac 56d 79h   08c 13h 26a 4bd 59g 7ef   0af 15b 2dh 37c 489 6eg
    036 147 258 9cf adg beh   04h 1df 29e 38g 57a 6bc   07d 169 24g 3ae 5ch 8bf   05e 1cg 27b 39d 46f 8ah

78: 0ch 13e 29d 48a 57g 6bf   036 147 258 9ab cde fgh   07b 1dh 23a 4cg 569 8ef   0af 189 2eg 37h 46d 5bc
    08g 16c 24b 3df 5ah 79e   012 345 678 9cf adg beh   05d 1bg 27f 38c 49h 6ae   04e 15f 26h 39g 7ac 8bd

79: 0ch 13e 29d 48a 57g 6bf   012 345 678 9ab cde fgh   07b 1dh 23a 4cg 569 8ef   0af 189 2eg 37h 46d 5bc
    08g 16c 24b 3df 5ah 79e   036 147 258 9cf adg beh   05d 1bg 27f 38c 49h 6ae   04e 15f 26h 39g 7ac 8bd

88

80: 08c 1df 26a 39h 4eg 57b   04a 16e 2bg 38f 59d 7ch   012 345 678 9cf adg beh   0bf 15h 279 3ae 48d 6cg
036 147 258 9ab cde fgh   07e 19g 23d 4bc 56f 8ah   0dh 18b 2ef 37g 469 5ac   05g 13c 24h 6bd 7af 89e

81: 012 345 678 9ab cde fgh   08c 1df 26a 39h 4eg 57b   04a 16e 2bg 38f 59d 7ch   036 147 258 9cf adg beh
0bf 15h 279 3ae 48d 6cg   07e 19g 23d 4bc 56f 8ah   0dh 18b 2ef 37g 469 5ac   05g 13c 24h 6bd 7af 89e

82: 012 345 678 9ab cde fgh   0ac 15b 26f 3eg 48d 79h   0df 189 23h 4bg 57c 6ae   07g 1dh 24a 38f 59e 6bc
036 147 258 9cf adg beh   08b 16g 27e 39d 4ch 5af   04e 13c 29g 56d 7bf 8ah   05h 1ef 2bd 37a 469 8cg

83: 0ac 15b 26f 3eg 48d 79h   0df 189 23h 4bg 57c 6ae   07g 1dh 24a 38f 59e 6bc   012 345 678 9cf adg beh
08b 16g 27e 39d 4ch 5af   036 147 258 9ab cde fgh   04e 13c 29g 56d 7bf 8ah   05h 1ef 2bd 37a 469 8cg

84: 012 345 678 9ab cde fgh   0ch 15b 26d 389 4eg 7af   08a 1dh 23g 4bc 56f 79e   0bf 16e 24a 37h 59d 8cg
036 147 258 9cf adg beh   04d 18f 29h 3ae 57c 6bg   07g 13c 2ef 469 5ah 8bd   05e 19g 27b 3df 48h 6ac

85: 0ch 15b 26d 389 4eg 7af   08a 1dh 23g 4bc 56f 79e   0bf 16e 24a 37h 59d 8cg   012 345 678 9cf adg beh
036 147 258 9ab cde fgh   04d 18f 29h 3ae 57c 6bg   07g 13c 2ef 469 5ah 8bd   05e 19g 27b 3df 48h 6ac

86: 012 345 678 9ab cde fgh   07f 1bd 23g 48h 59e 6ac   0ae 15h 27d 38c 4bf 69g   036 147 258 9cf adg beh
08b 1cg 29h 3df 46e 57a   04c 189 2ef 3ah 56d 7bg   05g 13e 26b 49d 7ch 8af   0dh 16f 24a 379 5bc 8eg

87: 07f 1bd 23g 48h 59e 6ac   0ae 15h 27d 38c 4bf 69g   012 345 678 9cf adg beh   08b 1cg 29h 3df 46e 57a
04c 189 2ef 3ah 56d 7bg   036 147 258 9ab cde fgh   05g 13e 26b 49d 7ch 8af   0dh 16f 24a 379 5bc 8eg

88: 08h 16c 23g 4ae 59d 7bf   012 345 678 9cf adg beh   05e 18f 27d 3ah 4bc 69g   036 147 258 9ab cde fgh
0bd 139 24h 57g 6ef 8ac   0cg 15b 2af 38e 46d 79h   04f 1dh 29e 37c 56a 8bg   07a 1eg 26b 3df 489 5ch

89: 012 345 678 9ab cde fgh   08h 16c 23g 4ae 59d 7bf   036 147 258 9cf adg beh   05e 18f 27d 3ah 4bc 69g
0bd 139 24h 57g 6ef 8ac   0cg 15b 2af 38e 46d 79h   04f 1dh 29e 37c 56a 8bg   07a 1eg 26b 3df 489 5ch

90: 012 345 678 9ab cde fgh   07f 1bg 2ah 38e 46c 59d   036 147 258 9cf adg beh   08h 169 27d 3bf 4ae 5cg
05e 13c 26b 4dh 79g 8af   0ac 18d 24f 39h 57b 6eg   04g 15h 29e 37a 6df 8bc   0bd 1ef 23g 489 56a 7ch

91: 07f 1bg 2ah 38e 46c 59d   012 345 678 9cf adg beh   08h 169 27d 3bf 4ae 5cg   05e 13c 26b 4dh 79g 8af
036 147 258 9ab cde fgh   0ac 18d 24f 39h 57b 6eg   04g 15h 29e 37a 6df 8bc   0bd 1ef 23g 489 56a 7ch

92: 08b 15h 29g 37c 4df 6ae   012 345 678 9ab cde fgh   0dh 13g 26b 4ac 579 8ef   04e 18d 2af 39h 56c 7bg
0cg 16f 23e 489 5bd 7ah   036 147 258 9cf adg beh   05a 19e 27d 3bf 46g 8ch   07f 1bc 24h 38a 5eg 69d

93: 08b 15h 29g 37c 4df 6ae   036 147 258 9ab cde fgh   0dh 13g 26b 4ac 579 8ef   04e 18d 2af 39h 56c 7bg
0cg 16f 23e 489 5bd 7ah   012 345 678 9cf adg beh   05a 19e 27d 3bf 46g 8ch   07f 1bc 24h 38a 5eg 69d

94: 012 345 678 9ab cde fgh   08d 15f 269 3ch 4bg 7ae   0ah 13b 24f 57d 6cg 89e   07g 18c 2bd 3ef 46a 59h
036 147 258 9cf adg beh   0bf 16e 27h 38g 49d 5ac   05e 19g 23a 48h 6df 7bc   04c 1dh 2eg 379 56b 8af

95: 012 345 678 9ab cde fgh   0ah 18c 269 3ef 4bg 57d   08d 13b 24f 59h 6cg 7ae   036 147 258 9cf adg beh
0bf 16e 27h 38g 49d 5ac   05e 19g 23a 48h 6df 7bc   07g 15f 2bd 3ch 46a 89e   04c 1dh 2eg 379 56b 8af

96: 08d 15f 269 3ch 4bg 7ae   0ah 13b 24f 57d 6cg 89e   07g 18c 2bd 3ef 46a 59h   012 345 678 9cf adg beh
036 147 258 9ab cde fgh   0bf 16e 27h 38g 49d 5ac   05e 19g 23a 48h 6df 7bc   04c 1dh 2eg 379 56b 8af

97: 0ah 18c 269 3ef 4bg 57d   08d 13b 24f 59h 6cg 7ae   012 345 678 9cf adg beh   036 147 258 9ab cde fgh
0bf 16e 27h 38g 49d 5ac   05e 19g 23a 48h 6df 7bc   07g 15f 2bd 3ch 46a 89e   04c 1dh 2eg 379 56b 8af

98: 07g 18b 29e 3af 4dh 56c   036 147 258 9ab cde fgh   08h 19d 26f 3bc 4eg 57a   0ae 15f 23g 489 6bd 7ch
012 345 678 9cf adg beh   05d 13h 24b 69g 7ef 8ac   0bf 1cg 27d 38e 46a 59h   04c 16e 2ah 379 5bg 8df

99: 07g 18b 29e 3af 4dh 56c   012 345 678 9ab cde fgh   08h 19d 26f 3bc 4eg 57a   0ae 15f 23g 489 6bd 7ch
036 147 258 9cf adg beh   05d 13h 24b 69g 7ef 8ac   0bf 1cg 27d 38e 46a 59h   04c 16e 2ah 379 5bg 8df

100: 012 345 678 9ab cde fgh   0eg 1df 26b 389 4ch 57a   04a 16g 23h 59d 7bc 8ef   036 147 258 9cf adg beh
05c 13b 2af 48g 6dh 79e   07h 18c 29g 3ae 4bd 56f   0bf 15e 27d 3cg 469 8ah   08d 19h 24e 37f 5bg 6ac

101: 0eg 1df 26b 389 4ch 57a   04a 16g 23h 59d 7bc 8ef   012 345 678 9cf adg beh   05c 13b 2af 48g 6dh 79e
036 147 258 9ab cde fgh   07h 18c 29g 3ae 4bd 56f   0bf 15e 27d 3cg 469 8ah   08d 19h 24e 37f 5bg 6ac

102: 012 345 678 9ab cde fgh   08c 1df 26b 3ah 49e 57g   05f 19g 27a 38e 4bc 6dh   036 147 258 9cf adg beh

0ae 18h 24d 3cg 569 7bf   07d 13b 29h 48g 5ac 6ef   0bg 15e 23f 46a 7ch 89d   04h 16c 2eg 379 5bd 8af

103: 08c 1df 26b 3ah 49e 57g   05f 19g 27a 38e 4bc 6dh   012 345 678 9cf adg beh   0ae 18h 24d 3cg 569 7bf
036 147 258 9ab cde fgh   07d 13b 29h 48g 5ac 6ef   0bg 15e 23f 46a 7ch 89d   04h 16c 2eg 379 5bd 8af

104: 012 345 678 9ab cde fgh   08b 19e 23c 46g 5df 7ah   036 147 258 9cf adg beh   0cg 15h 27d 3bf 489 6ae
04e 18d 2af 39h 56c 7bg   05a 16f 29g 37e 4bd 8ch   0dh 13g 26b 4ac 579 8ef   07f 1bc 24h 38a 5eg 69d

105: 08b 19e 23c 46g 5df 7ah   012 345 678 9cf adg beh   0cg 15h 27d 3bf 489 6ae   04e 18d 2af 39h 56c 7bg
05a 16f 29g 37e 4bd 8ch   036 147 258 9ab cde fgh   0dh 13g 26b 4ac 579 8ef   07f 1bc 24h 38a 5eg 69d

106: 08f 13c 269 4dh 5ae 7bg   07h 16b 2af 38e 4cg 59d   012 345 678 9cf adg beh   0bd 1ef 2ch 37a 489 56g
036 147 258 9ab cde fgh   04a 15h 23g 6df 79e 8bc   05c 19g 27d 3bf 46e 8ah   0eg 18d 24b 39h 57f 6ac

107: 012 345 678 9ab cde fgh   08f 13c 269 4dh 5ae 7bg   07h 16b 2af 38e 4cg 59d   036 147 258 9cf adg beh
0bd 1ef 2ch 37a 489 56g   04a 15h 23g 6df 79e 8bc   05c 19g 27d 3bf 46e 8ah   0eg 18d 24b 39h 57f 6ac

108: 08h 169 27d 3bf 4ae 5cg   07b 13c 29g 4dh 56e 8af   036 147 258 9ab cde fgh   012 345 678 9cf adg beh
04c 1bg 26f 38e 59d 7ah   0df 15h 23a 46g 79e 8bc   0eg 18d 24b 39h 57f 6ac   05a 1ef 2ch 37g 489 6bd

109: 08h 169 27d 3bf 4ae 5cg   07b 13c 29g 4dh 56e 8af   012 345 678 9ab cde fgh   036 147 258 9cf adg beh
04c 1bg 26f 38e 59d 7ah   0df 15h 23a 46g 79e 8bc   0eg 18d 24b 39h 57f 6ac   05a 1ef 2ch 37g 489 6bd

110: 07h 13g 2af 49e 56c 8bd   08g 1ah 24c 39d 57e 6bf   04d 15f 23b 69h 7cg 8ae   036 147 258 9cf adg beh
05b 189 2eg 3ch 46a 7df   012 345 678 9ab cde fgh   0ef 1bc 26d 37a 48h 59g   0ac 16e 279 38f 4bg 5dh

111: 07h 13g 2af 49e 56c 8bd   08g 1ah 24c 39d 57e 6bf   04d 15f 23b 69h 7cg 8ae   012 345 678 9cf adg beh
05b 189 2eg 3ch 46a 7df   036 147 258 9ab cde fgh   0ef 1bc 26d 37a 48h 59g   0ac 16e 279 38f 4bg 5dh

112: 07g 13c 29d 46b 5ef 8ah   0af 16h 27e 39g 48d 5bc   08e 1bf 2cg 37a 49h 56d   036 147 258 9cf adg beh
04c 1ae 26f 3dh 579 8bg   05h 189 23b 4eg 6ac 7df   012 345 678 9ab cde fgh   0bd 15g 24a 38f 69e 7ch

113: 07g 13c 29d 46b 5ef 8ah   0af 16h 27e 39g 48d 5bc   08e 1bf 2cg 37a 49h 56d   036 147 258 9ab cde fgh
04c 1ae 26f 3dh 579 8bg   05h 189 23b 4eg 6ac 7df   012 345 678 9cf adg beh   0bd 15g 24a 38f 69e 7ch

114: 07g 13c 29d 46b 5ef 8ah   08e 16h 24a 39g 5bc 7df   036 147 258 9cf adg beh   05h 1bf 2cg 37a 48d 69e
04c 1ae 26f 3dh 579 8bg   012 345 678 9ab cde fgh   0af 189 23b 4eg 56d 7ch   0bd 15g 27e 38f 49h 6ac

115: 07g 13c 29d 46b 5ef 8ah   08e 16h 24a 39g 5bc 7df   036 147 258 9ab cde fgh   05h 1bf 2cg 37a 48d 69e
04c 1ae 26f 3dh 579 8bg   012 345 678 9cf adg beh   0af 189 23b 4eg 56d 7ch   0bd 15g 27e 38f 49h 6ac

116: 0dh 13c 26f 4ae 579 8bg   0eg 1bf 2ac 37h 489 56d   08f 16a 27e 39g 4bd 5ch   04c 15g 23b 69e 7df 8ah
036 147 258 9cf adg beh   07a 19h 24g 38d 5ef 6bc   012 345 678 9ab cde fgh   05b 18e 29d 3af 46h 7cg

117: 07a 13c 29d 46h 5ef 8bg   0eg 1bf 2ac 37h 489 56d   08f 16a 27e 39g 4bd 5ch   04c 15g 23b 69e 7df 8ah
036 147 258 9cf adg beh   012 345 678 9ab cde fgh   0dh 18e 24g 3af 579 6bc   05b 19h 26f 38d 4ae 7cg

118: 0dh 13c 26f 4ae 579 8bg   0eg 1bf 2ac 37h 489 56d   08f 16a 27e 39g 4bd 5ch   04c 15g 23b 69e 7df 8ah
036 147 258 9ab cde fgh   07a 19h 24g 38d 5ef 6bc   012 345 678 9cf adg beh   05b 18e 29d 3af 46h 7cg

119: 07a 13c 29d 46h 5ef 8bg   0eg 1bf 2ac 37h 489 56d   08f 16a 27e 39g 4bd 5ch   04c 15g 23b 69e 7df 8ah
036 147 258 9ab cde fgh   012 345 678 9cf adg beh   0dh 18e 24g 3af 579 6bc   05b 19h 26f 38d 4ae 7cg

Type vectors, group orders and 5- and 6-spreads of our class of NKTS(18)'s

No.	type vector	G	P_5 P_6	No.	type vector	G	P_5 P_6	No.	type vector	G	P_5 P_6
1	2 4 4 14 2 2	2	88 0	41	1 1 9 4 9 4	1	92 0	81	1 2 11 3 10 1	1	78 0
2	2 2 4 19 0 1	2	94 0	42	1 3 11 5 8 0	1	84 0	82	1 1 9 1 14 2	1	72 0
3	2 8 0 14 0 4	2	88 0	43	1 3 9 5 9 1	1	73 1	83	1 2 7 1 16 1	1	87 0
4	2 4 4 16 0 2	2	98 0	44	1 1 4 2 13 7	2	74 0	84	1 6 4 3 13 1	1	84 0
5	1 10 2 12 2 1	4	110 3	45	1 1 6 4 11 5	2	72 0	85	1 2 7 5 12 1	1	77 0
6	1 6 6 14 0 1	4	98 5	46	1 1 8 4 9 5	2	82 2	86	1 0 7 3 15 2	1	73 0
7	1 3 10 6 5 3	2	90 0	47	1 1 10 4 9 3	2	86 2	87	1 0 8 6 10 3	1	78 0
8	1 1 12 8 3 3	2	82 0	48	1 0 5 5 11 6	1	93 1	88	1 0 12 3 10 2	1	78 0
9	1 0 6 8 12 1	2	84 0	49	1 0 7 4 11 5	1	94 0	89	1 1 5 4 15 2	1	71 0
10	1 0 10 12 4 1	2	90 0	50	1 3 10 4 7 3	2	78 2	90	1 4 14 0 8 1	4	62 0
11	7 0 0 15 0 6	18	90 0	51	1 5 8 4 7 3	2	94 2	91	1 0 14 6 6 1	4	54 0
12	4 0 6 10 6 2	6	60 0	52	1 4 2 4 16 1	2	58 0	92	1 0 6 12 8 1	4	82 2
13	1 0 12 15 0 0	18	78 0	53	1 4 6 10 6 1	2	70 0	93	1 0 6 10 10 1	4	66 2
14	2 0 14 8 4 0	2	72 0	54	1 14 6 6 0 1	4	106 3	94	1 1 13 3 8 2	1	92 0
15	4 0 12 10 0 2	6	96 0	55	1 10 10 4 2 1	4	106 5	95	1 1 11 5 8 2	1	95 0
16	1 12 0 9 0 6	6	66 0	56	1 4 5 17 0 1	1	86 0	96	1 1 9 5 10 2	1	81 0
17	1 6 0 9 12 0	6	60 0	57	1 4 5 15 1 2	1	75 0	97	1 1 12 4 8 2	1	91 0
18	1 1 4 9 10 3	2	74 0	58	1 6 6 9 3 3	3	66 0	98	1 2 9 2 14 0	1	85 0
19	1 1 6 7 12 1	2	62 0	59	1 0 12 9 6 0	3	72 0	99	1 2 13 2 10 0	1	92 0
20	1 1 4 9 10 3	2	92 2	60	1 0 6 9 12 0	3	78 0	100	1 1 9 2 11 4	1	73 0
21	1 1 6 7 12 1	2	84 2	61	1 0 9 6 12 0	3	69 0	101	1 1 8 1 11 6	1	62 0
22	1 2 12 4 7 2	1	79 0	62	1 0 6 9 9 3	6	84 6	102	1 2 5 3 13 4	1	75 0
23	1 2 13 3 7 2	1	79 0	63	1 0 6 6 12 3	6	66 3	103	1 1 8 4 11 3	1	73 0
24	1 2 7 4 14 0	1	73 1	64	1 1 4 1 16 5	1	93 0	104	1 0 6 12 8 1	4	90 3
25	1 2 11 5 9 0	1	83 0	65	1 1 6 0 15 5	1	94 0	105	1 0 6 10 10 1	4	94 2
26	1 0 7 4 14 2	1	68 0	66	1 1 11 6 8 1	1	104 1	106	1 4 6 6 10 1	4	74 4
27	1 0 7 1 19 0	1	65 0	67	1 3 9 7 7 1	1	108 1	107	1 4 10 4 8 1	4	90 3
28	1 3 7 5 7 5	1	87 0	68	1 0 7 3 13 4	1	78 0	108	1 0 10 6 10 1	4	82 0
29	1 1 14 3 6 3	1	85 0	69	1 1 8 3 12 3	1	86 0	109	1 0 14 4 8 1	4	82 0
30	1 4 7 7 6 3	1	85 1	70	1 1 11 4 9 2	1	79 0	110	1 0 6 4 16 1	4	90 2
31	1 5 7 4 7 4	1	82 1	71	1 2 6 6 10 3	1	89 0	111	1 0 6 4 12 5	4	86 3
32	1 1 6 5 15 0	1	75 0	72	1 4 4 4 10 5	1	78 0	112	1 0 14 4 8 1	4	66 0
33	1 2 7 4 13 1	1	74 0	73	1 4 6 3 10 4	1	76 0	113	1 4 14 2 6 1	4	74 3
34	1 0 14 4 6 3	1	78 0	74	1 1 13 2 9 2	1	94 1	114	1 0 10 4 12 1	4	90 2
35	1 0 15 1 7 4	1	99 1	75	1 0 12 4 8 3	1	83 0	115	1 0 10 6 10 1	4	70 3
36	1 0 11 8 7 1	1	84 0	76	1 0 11 4 10 2	1	87 0	116	1 0 6 12 0 9	36	126 15
37	1 3 11 7 5 1	1	98 0	77	1 0 10 5 11 1	1	79 0	117	1 0 6 12 0 9	36	126 6
38	1 3 12 7 4 1	2	76 1	78	1 2 4 6 13 2	1	80 0	118	1 0 6 12 0 9	36	90 6
39	1 5 12 5 4 1	2	92 3	79	1 1 6 5 13 2	1	74 0	119	1 0 6 12 0 9	36	90 6
40	1 1 9 3 11 3	1	86 0	80	1 1 14 6 5 1	1	82 0				