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Transitive Graphs With Fewer Than Twenty Vertices

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Abstract. A graph is called *transitive* if its automorphism group acts transitively on the vertex set. We list the 1031 transitive graphs with fewer than 20 vertices, together with many of their properties.

1. Introduction. A *transitive* graph is one whose automorphism group acts transitively on its vertices. In this report we present a catalogue of all transitive graphs with fewer than 20 vertices. The only other catalogue of transitive graphs appears to be that of Yap [5], who considered transitive graphs with 13 or fewer vertices except those of degree 5. Unfortunately, Yap missed three graphs with 12 vertices. Our method of construction was completely different from that of Yap and involved extensive machine computation. However, a description of the constructive method would be too lengthy to include here. It will be presented in a future paper.

The number of transitive graphs found for each order and degree appears in Table 1. The same information, restricted to connected transitive graphs, appears in Table 2. Note that in both tables, the total for each order includes those with degree not in the table. Also, note that a transitive graph with n vertices and degree d is connected if $d \geqslant (n-1)/2$.

2. Terminology. Basic graph terminology not defined here can be found in Behzad and Chartrand [1]. Suppose X is a graph with vertex set $V(X) = \{1, 2, \ldots, n\}$ and edge set $E(X)$. We denote by $\mathrm{Aut}(X)$ the automorphism group of X and by $\mathrm{Aut}_1(X)$ the stabilizer in $\mathrm{Aut}(X)$ of vertex 1. We call X *transitive* if the action of $\mathrm{Aut}(X)$ on $V(X)$ is transitive.

Two partitions of $V(X)$ will be defined. Firstly, $\partial(X)$ is the partition of $V(X)$ such that vertices v and w are in the same cell if and only if $\partial(1, v) = \partial(1, w)$, where $\partial(x, y)$ is the distance in X between x and y. By convention, $\partial(x, y) = \infty$ if x and y are in different components of X. Secondly, $\alpha(X)$ is the partition of $V(X)$ whose cells are the orbits of $\mathrm{Aut}_1(X)$. We will say that X is *distance regular* if, for any cells $C_1, C_2 \in \partial(X)$, not necessarily distinct, and for any $v, w \in C_1$, vertex v is adjacent to the same number of vertices in C_2 as is vertex w. We will say that X is *distance transitive* if $\partial(X) = \alpha(X)$. For connected transitive graphs, these definitions correspond to those of Biggs [2]. It is easy to show that a distance transitive graph is also distance regular, but the converse need not be true.

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order	degree 0	1	2	3	4	5	6	7	8	total
1	1									1
2	1	1								2
3	1	0	1							2
4	1	1	1	1						4
5	1	0	1	0	1					3
6	1	1	2	2	1	1				8
7	1	0	1	0	1	0	1			4
8	1	1	2	3	3	2	1	1		14
9	1	0	2	0	3	0	2	0	1	9
10	1	1	2	3	4	4	3	2	1	22
11	1	0	1	0	2	0	2	0	1	8
12	1	1	4	7	11	13	13	11	7	74
13	1	0	1	0	3	0	4	0	3	14
14	1	1	2	3	6	6	9	9	6	56
15	1	0	3	0	8	0	12	0	12	48
16	1	1	3	7	16	27	40	48	48	286
17	1	0	1	0	4	0	7	0	10	36
18	1	1	4	7	16	24	38	45	54	380
19	1	0	1	0	4	0	10	0	14	60

TABLE 1. *Number of transitive graphs*

Suppose that X has diameter δ, not necessarily finite. Then X will be called *antipodal* if, for distinct vertices u, v, w, we have $\partial(u, v) = \partial(u, w) = \delta$ implies $\partial(v, w) = \delta$. A new graph $D = D(X)$, intuitively "X plus diagonals", can be defined by

$$V(D) = V(X) \quad \text{and} \quad E(D) = E(X) \cup \{vw \mid \partial(v, w) = \delta\},$$

where vw is the edge $\{v, w\}$. Obviously, $\mathrm{Aut}(X) \leqslant \mathrm{Aut}(D)$, so that D is transitive if X is.

A *t-arc* of X is a sequence $(v_0, v_1, \ldots, v_t)$ of vertices of X such that $v_{i-1}v_i \in E(X)$ for $1 \leqslant i \leqslant t$ and $v_{i-1} \neq v_{i+1}$ for $1 \leqslant i < t$. The *arc-transitivity* of X is defined to be the maximum value of t such that $\mathrm{Aut}(X)$ acts transitively on the t-arcs of X. A discussion of arc-transitivity may be found in Biggs [2].

Let π be a partition of $V(X)$ into possibly-empty subsets V_1 and V_2. The operation of *switching X about* π produces a graph Y, where

$$V(Y) = V(X), \quad \text{and}$$

$$E(Y) = \{vw \in E(X) \mid v, w \in V_1 \text{ or } v, w \in V_2\} \cup \{vw \notin E(X) \mid v \in V_1 \text{ and } w \in V_2\}.$$

order \ degree	0	1	2	3	4	5	6	7	8	total
1	1									1
2	0	1								1
3	0	0	1							1
4	0	0	1	1						2
5	0	0	1	0	1					2
6	0	0	1	2	1	1				5
7	0	0	1	0	1	0	1			3
8	0	0	1	2	3	2	1	1		10
9	0	0	1	0	3	0	2	0	1	7
10	0	0	1	3	3	4	3	2	1	18
11	0	0	1	0	2	0	2	0	1	7
12	0	0	1	4	10	12	13	11	7	64
13	0	0	1	0	3	0	4	0	3	13
14	0	0	1	3	5	6	8	9	6	51
15	0	0	1	0	7	0	12	0	12	44
16	0	0	1	4	13	25	39	47	48	272
17	0	0	1	0	4	0	7	0	10	35
18	0	0	1	5	12	23	36	45	53	365
19	0	0	1	0	4	0	10	0	14	59

TABLE 2. *Number of connected transitive graphs*

Switching provides an equivalence relation on the set of all graphs. Each equivalence class contains at most one transitive graph of odd order (see [4]). However, if the number of vertices is even, an equivalence class may contain many transitive graphs. Details appear in Section 5.

An important object associated with switching is the *switching graph*. The switching graph of X, denoted $\mathrm{Sw}(X)$, is defined to have vertex set $\{v \mid v \in V(X)\} \cup \{v' \mid v \in V(X)\}$ and edge set

$$E(\mathrm{Sw}(X)) = E(X) \cup \{v'w' \mid vw \in E(X)\} \cup \{vw' \mid v \neq w \text{ and } vw \notin E(X)\}.$$

If X has n vertices, $\mathrm{Sw}(X)$ has $2n$ vertices and is regular with degree $n - 1$. Godsil [3] has shown that two graphs X and Y are equivalent under switching if and only if their switching graphs are isomorphic. Clearly, $\mathrm{Sw}(X)$ is transitive whenever X is, but it is possible for a transitive switching graph to be not derived from any transitive graph. The only example in our catalogue is the icosahedron L37.

A large number of transitive graphs can be obtained from groups by means of the Cayley graph construction. Let G be a group, and H be a subset of G such that

(i) H does not contain the identity, and

(ii) $g \in H \Rightarrow g^{-1} \in H$ for all $g \in G$.

The *Cayley graph* of G with *connection set* H is the graph $X = X(G, H)$ with

$$V(X) = G \quad \text{and} \quad E(X) = \{\{g, gh\} \mid g \in G, h \in H\}.$$

X is a transitive graph on which G acts (by left multiplication) as a regular subgroup of $\mathrm{Aut}(X)$. If in fact $\mathrm{Aut}(X) \cong G$, X is called a *graphical regular representation* (GRR) of G. In Section 5 we will give some examples of transitive graphs which are not Cayley graphs for any group.

Let X and Y be any graphs. We will define three products of X and Y, all of which have vertex set $V(X) \times V(Y)$.

(a) The *cartesian* product $X \times Y$ has

$$E(X \times Y) = \{(x_1, y_1)(x_2, y_2) \mid x_1 = x_2 \text{ and } y_1y_2 \in E(Y), \text{ or } y_1 = y_2 \text{ and } x_1x_2 \in E(X)\}.$$

(b) The *tensor* product (*conjunction*) $X * Y$ has

$$E(X * Y) = \{(x_1, y_1)(x_2, y_2) \mid x_1x_2 \in E(X) \text{ and } y_1y_2 \in E(Y)\}.$$

(c) The *lexicographic* product (*composition*) $X[Y]$ has

$$E(X[Y]) = \{(x_1, y_1)(x_2, y_2) \mid x_1x_2 \in E(X), \text{ or } x_1 = x_2 \text{ and } y_1y_2 \in E(Y)\}.$$

Note that $X \times Y \cong Y \times X$ and $X * Y \cong Y * X$, but that $X[Y] \not\cong Y[X]$, in general.

3. **Groups of Order** n, $5 \leqslant n \leqslant 19$. In this section we give a list of all groups with orders 5 through 19, with their elements and some statistics. This information will be needed in Section 4, where we give representations of transitive graphs as Cayley graphs. Within each order, the abelian groups precede the nonabelian ones. Each group is generated by those elements $A, B, C, \ldots$ which appear in the list of relators. Inverses $A^{-1}, B^{-1}, C^{-1}, \ldots$ are abbreviated to $Z, Y, X, \ldots$, respectively. A number following a letter raises that letter to the given power. A number which begins a word raises that whole word to the given power.

For example, BA3 means BA^3, 3Z2C means $(A^{-2}C)^3$.

(a) *List of Relators*: For example, the relators 4A 4B ZYAB show that group 16-3 is $\langle A, B \mid A^4 = B^4 = A^{-1}B^{-1}AB = 1\rangle$.

(b) *Statistics*:

INV = number of involutions,

EXP = exponent,

CNTR = order of centre,

COMM = order of commutator subgroup,

NSQ = number of squares (including 1).

(c) *List of Elements*: Each element is given as a word of shortest possible length in the generators and their inverses. Those words before the comma are involutions, while those after the comma are one element of each pair $\{g, g^{-1}\}$, where the order of g is greater than 2. If there is no comma, each element is an involution.

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GROUP NUMBER  5-1   RELATORS: 5A.
 INV= 0  EXP= 5  CNTR= 5  COMM= 1  NSQ= 5
 ELEMENTS: , A A2.

GROUP NUMBER  6-1   RELATORS: 6A.
 INV= 1  EXP= 6  CNTR= 6  COMM= 1  NSQ= 3
 ELEMENTS: A3, A A2.

GROUP NUMBER  6-2   RELATORS: 2A 3B 2AB.
 INV= 3  EXP= 3  CNTR= 1  COMM= 3  NSQ= 3
 ELEMENTS: A AB AY, B.

GROUP NUMBER  7-1   RELATORS: 7A.
 INV= 0  EXP= 7  CNTR= 7  COMM= 1  NSQ= 7
 ELEMENTS: , A A2 A3.

GROUP NUMBER  8-1   RELATORS: 8A.
 INV= 1  EXP= 8  CNTR= 8  COMM= 1  NSQ= 4
 ELEMENTS: A4, A A2 A3.

GROUP NUMBER  8-2   RELATORS: 4A 2B ZBAB.
 INV= 3  EXP= 4  CNTR= 8  COMM= 1  NSQ= 2
 ELEMENTS: B A2 A2B, A AB.

GROUP NUMBER  8-3   RELATORS: 2A 2B 2C 2AB 2AC 2BC.
 INV= 7  EXP= 2  CNTR= 8  COMM= 1  NSQ= 1
 ELEMENTS: A B C AB AC BC ABC.

GROUP NUMBER  8-4   RELATORS: 4A 2B 2AB.
 INV= 5  EXP= 4  CNTR= 2  COMM= 2  NSQ= 2
 ELEMENTS: B A2 AB BA A2B, A.

GROUP NUMBER  8-5   RELATORS: 4A Y2A2 YABA.
 INV= 1  EXP= 4  CNTR= 2  COMM= 2  NSQ= 2
 ELEMENTS: A2, A B AB.

GROUP NUMBER  9-1   RELATORS: 9A.
 INV= 0  EXP= 9  CNTR= 9  COMM= 1  NSQ= 9
 ELEMENTS: , A A2 A3 A4.

GROUP NUMBER  9-2   RELATORS: 3A 3B ZYAB.
 INV= 0  EXP= 3  CNTR= 9  COMM= 1  NSQ= 9
 ELEMENTS: , A B AB AY.

GROUP NUMBER 10-1   RELATORS: 10A.
 INV= 1  EXP=10  CNTR=10  COMM= 1  NSQ= 5
 ELEMENTS: A5, A A2 A3 A4.

GROUP NUMBER 10-2   RELATORS: 5A 2B 2AB.
 INV= 5  EXP= 5  CNTR= 1  COMM= 5  NSQ= 5
 ELEMENTS: B AB BA A2B BA2, A A2.

GROUP NUMBER 11-1   RELATORS: 11A.
 INV= 0  EXP=11  CNTR=11  COMM= 1  NSQ=11
 ELEMENTS: , A A2 A3 A4 A5.

GROUP NUMBER 12-1   RELATORS: 12A.
 INV= 1  EXP=12  CNTR=12  COMM= 1  NSQ= 6
 ELEMENTS: A6, A A2 A3 A4 A5.

GROUP NUMBER 12-2   RELATORS: 6A 2B ZYAB.
 INV= 3  EXP= 6  CNTR=12  COMM= 1  NSQ= 3
 ELEMENTS: B A3 A3B, A A2 AB A2B.

GROUP NUMBER 12-3   RELATORS: 6A 2B 2AB.
 INV= 7  EXP= 6  CNTR= 2  COMM= 3  NSQ= 3
 ELEMENTS: B AB BA A3 A2B BA2 A3B, A A2.

GROUP NUMBER 12-4   RELATORS: 2A 2B 3C BXAC BAXBC 2AB.
 INV= 3  EXP= 3  CNTR= 1  COMM= 4  NSQ= 9
 ELEMENTS: A B AB, C AC AX BC.
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GROUP NUMBER 12-5 RELATORS: 6A Y2A3 AYAB.
INV= 1 EXP= 6 CNTR= 2 COMM= 3 NSQ= 4
ELEMENTS: B2, A B A2 AB BA.

GROUP NUMBER 13-1 RELATORS: 13A.
INV= 0 EXP=13 CNTR=13 COMM= 1 NSQ=13
ELEMENTS: , A A2 A3 A4 A5 A6.

GROUP NUMBER 14-1 RELATORS: 14A.
INV= 1 EXP=14 CNTR=14 COMM= 1 NSQ= 7
ELEMENTS: A7, A A2 A3 A4 A5 A6.

GROUP NUMBER 14-2 RELATORS: 7A 2B 2AB.
INV= 7 EXP= 7 CNTR= 1 COMM= 7 NSQ= 7
ELEMENTS: B AB BA A2B BA2 A3B BA3, A A2 A3.

GROUP NUMBER 15-1 RELATORS: 15A.
INV= 0 EXP=15 CNTR=15 COMM= 1 NSQ=15
ELEMENTS: , A A2 A3 A4 A5 A6 A7.

GROUP NUMBER 16-1 RELATORS: 16A.
INV= 1 EXP=16 CNTR=16 COMM= 1 NSQ= 8
ELEMENTS: A8, A A2 A3 A4 A5 A6 A7.

GROUP NUMBER 16-2 RELATORS: 8A 2B ZYAB.
INV= 3 EXP= 8 CNTR=16 COMM= 1 NSQ= 4
ELEMENTS: B A4 A4B, A A2 AB A3 A2B A3B.

GROUP NUMBER 16-3 RELATORS: 4A 4B ZYAB.
INV= 3 EXP= 4 CNTR=16 COMM= 1 NSQ= 4
ELEMENTS: A2 B2 A2B2, A B AB AY A2B AB2.

GROUP NUMBER 16-4 RELATORS: 4A 2B 2C ZBAB 2BC ZCAC.
INV= 7 EXP= 4 CNTR=16 COMM= 1 NSQ= 2
ELEMENTS: B C A2 BC A2B A2C A2BC, A AB AC ABC.

GROUP NUMBER 16-5 RELATORS: 2A 2B 2C 2D 2AB 2AC 2AD 2BC 2BD 2CD.
INV=15 EXP= 2 CNTR=16 COMM= 1 NSQ= 1
ELEMENTS: A B C D AB AC AD BC BD CD ABC ABD ACD BCD ABCD.

GROUP NUMBER 16-6 RELATORS: 4A 2B 2C 2AB ZCAC 2CB.
INV=11 EXP= 4 CNTR= 4 COMM= 2 NSQ= 2
ELEMENTS: B C A2 AB BA BC A2B A2C ABC BAC A2BC, A AC.

GROUP NUMBER 16-7 RELATORS: 4A 2B X2A2 AXAC XBCB ZBAB.
INV= 3 EXP= 4 CNTR= 4 COMM= 2 NSQ= 2
ELEMENTS: B A2 A2B, A C AB AC BC ABC.

GROUP NUMBER 16-8 RELATORS: 4A 2B X2A2 AXAC 2BC ZBAB.
INV= 7 EXP= 4 CNTR= 4 COMM= 2 NSQ= 2
ELEMENTS: B A2 BC BX A2B ABC ABX, A C AB AC.

GROUP NUMBER 16-9 RELATORS: 4A 2B X2B YAXAC ZBAB.
INV= 7 EXP= 4 CNTR= 4 COMM= 2 NSQ= 3
ELEMENTS: B A2 AC AX CA ZC A2B, A C AB A2C.

GROUP NUMBER 16-10 RELATORS: 4A 4B AYAB.
INV= 3 EXP= 4 CNTR= 4 COMM= 2 NSQ= 3
ELEMENTS: A2 B2 A2B2, A B AB BA A2B AB2.

GROUP NUMBER 16-11 RELATORS: 8A 2B Z5BAB.
INV= 3 EXP= 8 CNTR= 4 COMM= 2 NSQ= 4
ELEMENTS: B ABZ A4, A A2 AB BA A3 A2B.

GROUP NUMBER 16-12 RELATORS: 8A 2B 2AB.
INV= 9 EXP= 8 CNTR= 2 COMM= 4 NSQ= 4
ELEMENTS: B AB BA A2B BA2 A4 A3B BA3 A4B, A A2 A3.

GROUP NUMBER 16-13 RELATORS: 8A 2B Z3BAB.
INV= 5 EXP= 8 CNTR= 2 COMM= 4 NSQ= 4
ELEMENTS: B A2B ABA ABZ A4, A A2 AB BA A3.

GROUP NUMBER 16-14 RELATORS: 8A Y2A4 AYAB.
INV= 1 EXP= 8 CNTR= 2 COMM= 4 NSQ= 4
ELEMENTS: B2, A B A2 AB BA A3 A2B.

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GROUP NUMBER 17-1   RELATORS: 17A.
 INV= 0  EXP=17  CNTR=17  COMM= 1  NSQ=17
 ELEMENTS: , A A2 A3 A4 A5 A6 A7 A8.

GROUP NUMBER 18-1   RELATORS: 18A.
 INV= 1  EXP=18  CNTR=18  COMM= 1  NSQ= 9
 ELEMENTS: A9, A A2 A3 A4 A5 A6 A7 A8.

GROUP NUMBER 18-2   RELATORS: 6A 3B ZYAB.
 INV= 1  EXP= 6  CNTR=18  COMM= 1  NSQ= 9
 ELEMENTS: A3, A B A2 AB AY A2B A2Y A3B.

GROUP NUMBER 18-3   RELATORS: 3A 6B AYAB.
 INV= 3  EXP= 6  CNTR= 3  COMM= 3  NSQ= 9
 ELEMENTS: B3 AB3 BAB2, A B AB BA B2 AB2 AY2.

GROUP NUMBER 18-4   RELATORS: 9A 2B 2AB.
 INV= 9  EXP= 9  CNTR= 1  COMM= 9  NSQ= 9
 ELEMENTS: B AB BA A2B BA2 A3B BA3 A4B BA4, A A2 A3 A4.

GROUP NUMBER 18-5   RELATORS: 3A 3B 2C 2AC 2BC ZYAB.
 INV= 9  EXP= 3  CNTR= 1  COMM= 9  NSQ= 9
 ELEMENTS: C AC BC CA CB ABC ACB BCA CAB, A B AB AY.

GROUP NUMBER 19-1   RELATORS: 19A.
 INV= 0  EXP=19  CNTR=19  COMM= 1  NSQ=19
 ELEMENTS: , A A2 A3 A4 A5 A6 A7 A8 A9.
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4. **Transitive Graphs of Order** n, $2 \leqslant n \leqslant 19$. The catalogue in this section contains data on every transitive graph with n vertices and degree d, for $2 \leqslant n \leqslant 9$ (any d) and $10 \leqslant n \leqslant 19$ (for $d \leqslant (n-1)/2$). Those with the remaining degrees can be obtained by complementation. In describing the information presented for some particular graph, we will refer to the graph as X, and use n and d to denote its order and degree, respectively.

(a) *Set Notation*: A set of positive integers can be written as an octal integer by putting bit i equal to 1 if and only if i is in the set. The bits are numbered from 1, starting at the right hand (low order) end. For example, 251 (octal) is 10101001 (binary) and so represents the set $\{1, 4, 6, 8\}$.

(b) *First Line of Data*: The first item in this line is the *name* of X, for example L20 or P16. The letter indicates the order of X (A for 1, B for 2, etc.), and the numbers are allotted sequentially within each order. Care must be taken to avoid confusing names like $K3$ with the commonly accepted notations [1] for special graphs, for example K_3, C_5, $K_{3,4}$. The latter notations will be used in this description of the catalogue, but *never* in the catalogue itself.

We now describe the other pieces of information which may occur on the first line.

(i) DEG: degree of X.

(ii) F: flags associated with X. Each flag is a single letter whose presence indicates a special property. If no flags apply, the F is omitted. The flags used are listed below.

X = disconnected.

N = not a Cayley graph.

T = distance transitive.

R = distance regular but not distance transitive (only case is P84).

V = Aut(X) acts primitively on $V(X)$.

	I =	$\mathrm{Aut}(X)$ satisfies this condition: For any $v, w \in V(X)$ there is $\alpha \in \mathrm{Aut}(X)$ such that $v^\alpha = w$ and $w^\alpha = v$.
	A =	antipodal.
	S =	self-complementary.
	P =	planar.
(iii)	AUT:	order of $\mathrm{Aut}_1(X)$.
(iv)	P:	partitions $\partial(X)$ and $\alpha(X)$. Each digit or letter gives the size of one cell of a partition π of $V(X)$. Letters are used for cell sizes over 9; A for 10, B for 11, etc.
		Case 1: If $n = 2$ or X is not a GRR, then π is $\alpha(X)$. The cells of $\alpha(X)$ are grouped by commas into the cells of $\partial(X)$. For example, P = (1, 4, 24, 1) indicates that $\alpha(X)$ has one 4-cell at distance 1 from vertex 1, a 2-cell and a 4-cell at distance 2, and a single 1-cell at distance 3. If X is disconnected, only vertices in the component containing vertex 1 are included; the presence of additional components is indicated by a "+" sign.
		Case 2: If $n \neq 2$ and X is a GRR, then π is $\partial(X)$. To avoid confusion with Case 1, the cells are separated by slashes. For example, P = (1/6/8/1) indicates 6 vertices at distance 1 from vertex 1, 8 vertices at distance 2, and 1 vertex at distance 3.
(v)	GIR:	girth of X, unless X is acyclic.
(vi)	CN:	chromatic numbers of X and $\bar{X}$, respectively.
(vii)	T:	arc-transitivity of X, unless $\mathrm{Aut}(X)$ is not transitive on 1-arcs, or $d = 0$, or $d = 2$.
(viii)		Any other text on the first line indicates a common name for X, for example "PETERSEN GRAPH".

(c) *Adjacency Matrix* (omitted if $d = 0$).

$$A = a_2\ a_3\ a_4\ a_5, a_6 \cdots a_n.$$

Each a_i is an octal representation (see part (a)) of the set of vertices preceding vertex i which are adjacent to i. Note that a_1 is omitted. The labelling of the vertices of X is consistent with the partition P described above. For example, if P = (1, 4, 24, 1), $\alpha(X)$ is $\{1 \mid 2, 3, 4, 5 \mid 6, 7 \mid 8, 9, 10, 11 \mid 12\}$ and $\partial(X)$ is $\{1 \mid 2, 3, 4, 5 \mid 6, 7, 8, 9, 10, 11 \mid 12\}$.

Example: If $A = 1\ 1\ 6$, we have 2 adjacent to 1, 3 adjacent to 1 and 4 adjacent to 2 and 3.

(d) *Eigenvalues of Adjacency Matrix* (omitted if X is disconnected).

$$E = m_1\lambda_1\ m_2\lambda_2 \cdots.$$

Each field gives one eigenvalue of the adjacency matrix of X. If the eigenvalue has multiplicity other than one, this multiplicity is written immediately before the eigenvalue, using an intervening "+" for nonnegative eigenvalues. If the eigenvalues for X are $\lambda_1 \leqslant \lambda_2 \leqslant \cdots \leqslant \lambda_n$, those for $\bar{X}$ are $-\lambda_{n-1} - 1 \leqslant -\lambda_{n-2} - 1 \leqslant \cdots \leqslant -\lambda_1 - 1 \leqslant n - d - 1$.

Example: $E = -4\ 3 - \cdot 4391\ 2 + 0\ 1 \cdot 3417\ 5$
—the eigenvalues are $-0{\cdot}4391$ (3 times), 0 (twice) and -4, $1{\cdot}3417$, 5 (once each).

(e) *Independent Sets and Cliques* (omitted if X is disconnected).

$$K = (\alpha_3\ \alpha_4, \ldots, \beta_3\ \beta_4 \cdots).$$

α_i is the number of independent sets of size i in X, i.e. cliques of size i in $\overline{X}$, which include vertex 1.

β_i is the number of cliques of size i in X which include vertex 1.

Those numbers before the comma are α's; those after the comma are β's. The total number of independent sets or cliques of size i in X is $n\alpha_i/i$ or $n\beta_i/i$, respectively.

Example: $K = (, 4\ 1)$. X has no independent sets of size 3 or greater. Vertex 1 is contained in 4 triangles and 1 clique of size 4.

(f) *Representations of X*. The data provided about X contain a number of descriptors expressing X as a product etc. In explaining each descriptor type, Y and Z stand for the names of transitive graphs in the catalogue. As before, n and d are the order and degree of X, respectively. The variable i indicates a positive integer.

(i) $-Y$: complement of Y, unless X is self-complementary.

(ii) $i[Y]$: X is the disjoint union of i copies of Y ($i > 1$), unless $d \leqslant 1$.

(iii) $L(Y)$: linegraph of Y, unless $d \leqslant 2$.

(iv) $-L(Y)$: complement of $L(Y)$, unless $d \leqslant 2$ or X is complete.

(v) $SW(Y)$: switching graph of Y.

(vi) $SW(Y+)$: switching graph of the disjoint union $Y \cup K_1$, unless Y is complete or empty. The only example is L37. All switching graphs in the catalogue are either type (v) or type (vi).

(vii) $D(Y)$: Y plus diagonals (see Section 2), provided Y has diameter at least 3 and is connected.

(viii) $-D(Y)$: complement of $D(Y)$. This notation is omitted if Y is bipartite and has diameter 3. In that case $-D(Y)$ is the disjoint union of two cliques. Y is connected with diameter $\geqslant 3$.

(ix) $Wi(Y)$: generalized linegraph of subdivision graph ($1 \leqslant i \leqslant 9$). Form a multigraph from Y by replacing each edge by i parallel edges. Then subdivide each edge with a new vertex and take the linegraph of the result. Omitted if Y has degree $\leqslant 1$, or X has degree 2.

Every linegraph in the catalogue is of type (iii) or type (ix) except these:

$$L(K_{1,m}) = K_m \qquad (2 \leqslant m \leqslant 19),$$

$$L(K_{3,m}) = K_3 \times K_m \qquad (4 \leqslant m \leqslant 6).$$

(x) $-Wi(Y)$: complement of $Wi(Y)$ ($1 \leqslant i \leqslant 9$), unless Y has degree $\leqslant 1$, or $Wi(Y)$ has degree 2.

(xi) $Y[Z]$: lexicographic product of Y around Z, unless $d \leqslant 1$. If Y is empty (i.e. $\overline{Y}$ is complete), the notation (ii) is used instead.

(xii) $Y \times Z$: cartesian product of Y and Z, unless either Y or Z is empty.

(xiii) $-Y \times Z$: complement of $Y \times Z$, unless X is complete.

(xiv) $Y * Z$: tensor product of Y and Z, unless $d \leqslant 1$.

(xv) $-Y * Z$: complement of $Y * Z$, unless X is either empty or complete.

(xvi) i/m: X is the Cayley graph $X(G, H)$, where G is the ith group of order n, and the connection set H is specified by the octal number m (see (a)). The groups and their elements are numbered in the order they are listed in Section 3; an element and its inverse have the same ordinal. H is not canonical in any sense.

Example: If $n = 16$, the notation 3/123 represents $X(G, H)$, where G is group 16-3 and H is $\{A^2, B^2, B^{\pm 1}, (AB^{-1})^{\pm 1}\}$. Cayley graph representation is only given if $2 \leqslant d \leqslant (n-1)/2$.

Orders two through fifteen are presented here. Sixteen through nineteen appear in the microfiche supplement accompanying this issue.

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  TRANSITIVE GRAPHS ON  2 VERTICES

B1  DEG=0 F=XTVIAP AUT=1  P=(1,+)  CN=1,2
-B2 SW(A1)

B2  DEG=1 F=TVIAP AUT=1  P=(1,1)  CN=2,1  T=1
A=1  E=-1 1  K=(,)  -B1

  TRANSITIVE GRAPHS ON  3 VERTICES

C1  DEG=0 F=XTVIAP AUT=2  P=(1,+)  CN=1,3
-C2 -L(C2)

C2  DEG=2 F=TVIAP AUT=2  P=(1,2)  GIR=3 CN=3,1   TRIANGLE
A=1 3  E=2-1 2  K=(,1)  -C1

  TRANSITIVE GRAPHS ON  4 VERTICES

D1  DEG=0 F=XTVIAP AUT=6  P=(1,+)  CN=1,4
-D4

D2  DEG=1 F=XTIP AUT=2  P=(1,1,+)  CN=2,2  T=1
A=1 0 4  -D3 -L(D3) SW(B1) SW(B2) -B2XB2

D3  DEG=2 F=TIAP AUT=2  P=(1,2,1)  GIR=4 CN=2,2   SQUARE
A=1 1 6  E=-2 2+0 2  K=(,)  -D2 B2[B1] B2XB2 -B1XB2 -B2*B2

D4  DEG=3 F=TVIAP AUT=6  P=(1,3)  GIR=3 CN=4,1  T=2  TETRAHEDRON
A=1 3 7  E=3-1 3  K=(,3 1)  -D1 B2[B2]

  TRANSITIVE GRAPHS ON  5 VERTICES

E1  DEG=0 F=XTVIAP AUT=24  P=(1,+)  CN=1,5
-E3

E2  DEG=2 F=TVISP AUT=2  P=(1,2,2)  GIR=5 CN=3,3   PENTAGON
A=1 1 4 12  E=2-1.61803 2+.61803 2  K=(,)  -L(E2) 1/1

E3  DEG=4 F=TVIA AUT=24  P=(1,4)  GIR=3 CN=5,1  T=2
A=1 3 7 17  E=4-1 4  K=(,6 4 1)  -E1
```

TRANSITIVE GRAPHS ON 6 VERTICES

F1 DEG=0 F=XTVIAP AUT=120 P=(1,+) CN=1,6
-F8

F2 DEG=1 F=XTIP AUT=8 P=(1,1,+) CN=2,3 T=1
A=1 0 4 0,20 -F7 -L(D4)

F3 DEG=2 F=XTIP AUT=12 P=(1,2,+) GIR=3 CN=3,2
A=1 3 0 10,30 2[C2] -F5 SW(C2) 1/4 2/10

F4 DEG=2 F=TIAP AUT=2 P=(1,2,2,1) GIR=6 CN=2,3 HEXAGON
A=1 1 4 2,30 E=-2 2-1 2+1 2 K=(1,) -F6 SW(C1) -B2XC2 B2*C2 1/2 2/6

F5 DEG=3 F=TIA AUT=12 P=(1,3,2) GIR=4 CN=2,3 T=3
A=1 1 1 16,16 E=-3 4+0 3 K=(1,) -F3 -L(F3) D(F4) B2[C1] -B1XC2

F6 DEG=3 F=IP AUT=2 P=(1,12,2) GIR=3 CN=3,2 PRISM
A=1 1 5 12,26 E=2-2 2+0 1 3 K=(,1) -F4 -L(F4) W3(B2) -W1(C2) B2XC2 -B2*C2

F7 DEG=4 F=TIAP AUT=8 P=(1,4,1) GIR=3 CN=3,2 T=1 OCTAHEDRON
A=1 1 7 7,36 E=2-2 3+0 4 K=(,4) -F2 L(D4) -W1(F2) C2[B1] -B2XC1

F8 DEG=5 F=TVIA AUT=120 P=(1,5) GIR=3 CN=6,1 T=2
A=1 3 7 17,37 E=5-1 5 K=(,10 10 5 1) -F1 B2[C2] C2[B2]

TRANSITIVE GRAPHS ON 7 VERTICES

G1 DEG=0 F=XTVIAP AUT=720 P=(1,+) CN=1,7
-G4

G2 DEG=2 F=TVIP AUT=2 P=(1,2,2,2) GIR=7 CN=3,4 HEPTAGON
A=1 1 4 2,20 50 E=2-1.80194 2-.44504 2+1.24698 2 K=(3,) -G3 -D(G2) 1/1

G3 DEG=4 F=VI AUT=2 P=(1,22,2) GIR=3 CN=4,3
A=1 3 5 3,34 72 E=2-2.24698 2-.55496 2+.80194 4 K=(,3) -G2 -L(G2) D(G2)

G4 DEG=6 F=TVIA AUT=720 P=(1,6) GIR=3 CN=7,1 T=2
A=1 3 7 17,37 77 E=6-1 6 K=(,15 20 15 6 1) -G1

TRANSITIVE GRAPHS ON 8 VERTICES

H1 DEG=0 F=XTVIAP AUT=5040 P=(1,+) CN=1,8
-H14

H2 DEG=1 F=XTIP AUT=48 P=(1,1,+) CN=2,4 T=1
A=1 0 4 0,20 0 100 -H13

H3 DEG=2 F=XTIP AUT=16 P=(1,2,1,+) GIR=4 CN=2,4
A=1 1 6 0,20 20 140 2[D3] -H11 D2[B1] B2XD2 B2*D3 1/4 2/5 3/104 4/22 5/2

H4 DEG=2 F=TIAP AUT=2 P=(1,2,2,2,1) GIR=8 CN=2,4 OCTAGON
A=1 1 4 2,20 10 140 E=-2 2-1.41421 2+0 2+1.41421 2 K=(6 1,) -H12 1/10 4/11

H5 DEG=3 F=XTIP AUT=144 P=(1,3,+) GIR=3 CN=4,2 T=2
A=1 3 7 0,20 60 160 2[D4] -H8 SW(D2) SW(D4) D2[B2] 1/5 2/22 3/70 4/42 5/3

H6 DEG=3 F=I AUT=2 P=(1,12,22) GIR=4 CN=3,4
A=1 1 1 10,24 52 26 E=2-2.41421 -1 2+.41421 2+1 3 K=(3,) -H10 D(H4) 1/11
4/26

H7 DEG=3 F=TIAP AUT=6 P=(1,3,3,1) GIR=4 CN=2,4 T=2 CUBE
A=1 1 1 14,12 6 160 E=-3 3-1 3+1 3 K=(3 1,) -H9 SW(D1) SW(D3) -W4(B2) B2XD3
-B2XD4 B2*D4 2/11 3/45 4/15

H8 DEG=4 F=TIA AUT=144 P=(1,4,3) GIR=4 CN=2,4 T=3
A=1 1 1 1,36 36 36 E=-4 6+0 4 K=(3 1,) -H5 D(H7) B2[D1] D3[B1] -B1XD4

H9 DEG=4 F=I AUT=6 P=(1,13,3) GIR=3 CN=4,2
A=1 1 5 15,12 62 146 E=3-2 3+0 2 4 K=(,3 1) -H7 W4(B2) B2XD4 -B2XD3 -B2*D4

TRANSITIVE GRAPHS ON 8 VERTICES (CONTD)

H10 DEG=4 F=IP AUT=2 P=(1,22,12) GIR=3 CN=4,3 ANTIPRISM
A=1 1 5 13,6 54 162 E=2-2 2-1.41421 0 2+1.41421 4 K=(,3) -H6 -D(H4)

H11 DEG=5 F=I AUT=16 P=(1,14,2) GIR=3 CN=4,2
A=1 3 3 7,13 74 174 E=-3 4-1 2+1 5 K=(,6 2) -H3 -L(H3) -W2(D2) B2[D2] D3[B2]
-B1XD3 -B2XD2 -B2*D3

H12 DEG=5 F=I AUT=2 P=(1,122,2) GIR=3 CN=4,2
A=1 1 5 13,27 56 136 E=2-2.41421 2-1 2+.41421 1 5 K=(,6 1) -H4 -L(H4)
-W1(D3)

H13 DEG=6 F=TIA AUT=48 P=(1,6,1) GIR=3 CN=4,2 T=1
A=1 1 7 7,37 37 176 E=3-2 4+0 6 K=(,12 8) -H2 -W1(H2) B2[D3] D4[B1] -B1XD2
-B2XD1 -B2*D2

H14 DEG=7 F=TVIA AUT=5040 P=(1,7) GIR=3 CN=8,1 T=2
A=1 3 7 17,37 77 177 E=7-1 7 K=(,21 35 35 21 7 1) -H1 B2[D4] D4[B2]

TRANSITIVE GRAPHS ON 9 VERTICES

I1 DEG=0 F=XTVIAP AUT=40320 P=(1,+) CN=1,9
-I9

I2 DEG=2 F=XTIP AUT=144 P=(1,2,+) GIR=3 CN=3,3
A=1 3 0 10,0 30 40 240 3[C2] -I7 1/4 2/4

I3 DEG=2 F=TIP AUT=2 P=(1,2,2,2,2) GIR=9 CN=3,5 NONAGON
A=1 1 4 2,20 10 100 240 E=2-1.87939 2-1 2+.34730 2+1.53209 2 K=(10 4,) -I8
1/10

I4 DEG=4 F=TVIS AUT=8 P=(1,4,4) GIR=3 CN=3,3 T=1
A=1 3 1 11,24 12 154 162 E=4-2 4+1 4 K=(2,2) L(F5) -L(F5) C2XC2 -C2XC2 C2*C2
-C2*C2 2/12

I5 DEG=4 F=I AUT=2 P=(1,22,22) GIR=3 CN=3,3
A=1 3 1 1,34 32 124 252 E=2-2.87939 2-.65270 2+.53209 2+1 4 K=(3,1) -I6
-D(I3) 1/14

I6 DEG=4 F=I AUT=2 P=(1,22,22) GIR=3 CN=3,3
A=1 1 3 15,24 12 144 342 E=2-2 2-1.53209 2-.34730 2+1.87939 4 K=(1,3) -I5
D(I3) 1/11

I7 DEG=6 F=TIA AUT=144 P=(1,6,2) GIR=3 CN=3,3 T=1
A=1 1 1 17,17 17 176 176 E=2-3 6+0 6 K=(1,9) -I2 -L(I2) C2[C1] -C1XC2

I8 DEG=6 F=I AUT=2 P=(1,222,2) GIR=3 CN=5,3
A=1 3 5 13,27 17 174 372 E=2-2.53209 2-1.34730 2+0 2+.87939 6 K=(,10 4) -I3
-L(I3)

I9 DEG=8 F=TVIA AUT=40320 P=(1,8) GIR=3 CN=9,1 T=2
A=1 3 7 17,37 77 177 377 E=8-1 8 K=(,28 56 70 56 28 8 1) -I1 C2[C2]

TRANSITIVE GRAPHS ON 10 VERTICES

J1 DEG=0 F=XTVIAP AUT=362880 P=(1,+) CN=1,10

J2 DEG=1 F=XTIP AUT=384 P=(1,1,+) CN=2,5 T=1
A=1 0 4 0,20 0 100 0 400

J3 DEG=2 F=XTIP AUT=20 P=(1,2,2,+) GIR=5 CN=3,6
A=1 1 4 12,0 40 0 300 240 2[E2] 1/4 2/40

J4 DEG=2 F=TIAP AUT=2 P=(1,2,2,2,2,1) GIR=10 CN=2,5 POLYGON
A=1 1 4 2,20 10 100 40 600 E=-2 2-1.61803 2-.61803 2+.61803 2+1.61803 2
K=(15 10 1,) B2*E2 1/10 2/24

J5 DEG=3 F=I AUT=2 P=(1,12,22,2) GIR=4 CN=2,5
A=1 1 1 12,6 4 10 320 340 E=-3 2-1.61803 2-.61803 2+.61803 2+1.61803 3
K=(9 4 1,) D(J4) 1/3 2/7

TRANSITIVE GRAPHS ON 10 VERTICES (CONTD)

J6 DEG=3 F=IP AUT=2 P=(1,12,22,2) GIR=4 CN=3,5 PRISM
A=1 1 1 12,6 10 104 240 520 E=2-2.61803 2-.61803 2-.38197 1 2+1.61803 3
K=(9 4,) B2XE2 1/21 2/41

J7 DEG=3 F=NTVI AUT=12 P=(1,3,6) GIR=5 CN=3,5 T=3 PETERSEN GRAPH
A=1 1 1 10,22 10 102 144 224 E=4-2 5+1 3 K=(9 2,) -L(E3)

J8 DEG=4 F=XTI AUT=2880 P=(1,4,+) GIR=3 CN=5,2 T=2
A=1 3 7 17,0 40 140 340 740 2[E3] SW(E3) 1/24 2/140

J9 DEG=4 F=I AUT=32 P=(1,4,14) GIR=4 CN=3,5 T=1
A=1 1 1 1,36 30 106 106 630 E=2-3.23607 5+0 2+1.23607 4 K=(6 2,) E2[B1] 1/14
2/130

J10 DEG=4 F=TIA AUT=24 P=(1,4,4,1) GIR=4 CN=2,5 T=2
A=1 1 1 1,34 32 26 16 740 E=-4 4-1 4+1 4 K=(6 4 1,) SW(E1) -W5(B2) -B2XE3
B2*E3 1/12 2/33

J11 DEG=4 F=IAP AUT=2 P=(1,22,22,1) GIR=3 CN=4,4 ANTIPRISM
A=1 1 3 15,24 12 44 302 740 E=2-2.23607 4-1 0 2+2.23607 4 K=(3,3) SW(E2)
-D(J11) -D(J6) 1/6 2/43

TRANSITIVE GRAPHS ON 11 VERTICES

K1 DEG=0 F=XTVIAP AUT=3628800 P=(1,+) CN=1,11

K2 DEG=2 F=TVIP AUT=2 P=(1,2,2,2,2,2) GIR=11 CN=3,6 POLYGON
A=1 1 4 2,20 10 100 40 400,1200
E=2-1.91899 2-1.30972 2-.28463 2+.83083 2+1.68251 2 K=(21 20 5,) 1/10

K3 DEG=4 F=VI AUT=2 P=(1,22,22,2) GIR=3 CN=4,4
A=1 1 3 15,24 12 102 44 640,1700
E=2-2.20362 2-1.59435 2-.47889 2-.23648 2+2.51334 4 K=(6,3) D(K2) -D(K3) 1/24

K4 DEG=4 F=VI AUT=2 P=(1,22,222) GIR=4 CN=3,6
A=1 1 1 1,34 32 104 242 424,1212
E=2-3.22871 2-1.08816 2+.37279 2+.54620 2+1.39788 4 K=(9 4,) 1/5

TRANSITIVE GRAPHS ON 12 VERTICES

L1 DEG=0 F=XTVIAP AUT=39916800 P=(1,+) CN=1,12

L2 DEG=1 F=XTIP AUT=3840 P=(1,1,+) CN=2,6 T=1
A=1 0 4 0,20 0 100 0 400,0 2000

L3 DEG=2 F=XTIP AUT=2592 P=(1,2,+) GIR=3 CN=3,4
A=1 3 0 10,0 30 40 0 240,400 2400 2[F3] 4[C2] 1/20 2/20 3/400 4/40 5/10

L4 DEG=2 F=XTIP AUT=256 P=(1,2,1,+) GIR=4 CN=2,6
A=1 1 6 0,20 0 20 240 100,100 3000 3[D3] F2[B1] B2XF2 1/10 2/5 3/110 4/5 5/4

L5 DEG=2 F=XTIP AUT=24 P=(1,2,2,1,+) GIR=6 CN=2,6
A=1 1 4 2,30 0 100 0 400,1200 500 2[F4] B2*F3 B2*F4 C2*D2 1/4 2/10 3/102 5/2

L6 DEG=2 F=TIAP AUT=2 P=(1,2,2,2,2,2,1) GIR=12 CN=2,6 POLYGON
A=1 1 4 2,20 10 100 40 400,200 3000 E=-2 2-1.73205 2-1 2+0 2+1 2+1.73205 2
K=(28 35 15 1,) 1/2 3/120

L7 DEG=3 F=XTIP AUT=6912 P=(1,3,+) GIR=3 CN=4,3 T=2
A=1 3 7 0,20 0 60 260 100,1100 3100 3[D4] F2[B2] 1/11 2/7 3/34 4/7 5/21

L8 DEG=3 F=XTI AUT=864 P=(1,3,2,+) GIR=4 CN=2,6 T=3
A=1 1 1 16,16 0 100 100 100,1600 1600 2[F5] D2[C1] B2*F5 1/5 2/12 3/106 5/3

L9 DEG=3 F=XIP AUT=24 P=(1,12,2,+) GIR=3 CN=3,4
A=1 1 5 12,26 0 100 100 200,1500 1600 2[F6] W3(D2) B2XF3 C2XD2 1/21 2/21 3/401
5/11

L10 DEG=3 F=P AUT=2 P=(1,12,22,22) GIR=3 CN=3,4
A=1 1 5 10,4 2 102 240 120,440 3020 E=3-2 3-1 2+0 3+2 3 K=(18 10,1) W1(D4)
4/11

L11 DEG=3 AUT=4 P=(1,12,122,12) GIR=4 CN=2,6
A=1 1 1 14,10 4 2 2 620,540 340 E=-3 2-1.73205 3-1 3+1 2+1.73205 3
K=(19 15 5 1,) 3/124

TRANSITIVE GRAPHS ON 12 VERTICES (CONTD)

L12 DEG=3 F=I AUT=2 P=(1,12,22,22) GIR=4 CN=3,6
A=1 1 1 12,6 10 4 200 500,1240 520 E=2-2.73205 3-1 2+0 2+.73205 2+2 3
K=(19 16 5,) D(L6) 1/41 3/32

L13 DEG=3 F=IAP AUT=2 P=(1,12,22,12,1) GIR=4 CN=2,6 PRISM
A=1 1 1 6,12 10 4 300 220,140 3400 E=-3 2-2 -1 4+0 1 2+2 3 K=(19 16 5 1,)
B2XF4 B2*F6 2/14 3/122

L14 DEG=4 F=XTIP AUT=384 P=(1,4,1,+) GIR=3 CN=3,4 T=1
A=1 1 7 7,36 0 100 100 700,700 3600 2[F7] L(H5) -D(L26) F3[B1] 1/24 2/120
3/600 5/12

L15 DEG=4 AUT=4 P=(1,112,122,2) GIR=3 CN=4,3
A=1 1 5 15,6 20 110 42 442,1300 2700 E=4-2 2-.73205 3+0 2+2.73205 4 K=(10,3 1)
W2(C2) 3/56

L16 DEG=4 AUT=2 P=(1,22,1222) GIR=3 CN=3,4
A=1 1 1 11,6 24 12 60 450,702 1304 E=3-2.56155 3-1 2+1 3+1.56155 4 K=(12 4,1)
4/103

L17 DEG=4 F=I AUT=2 P=(1,22,122,2) GIR=4 CN=2,6
A=1 1 1 1,6 34 32 22 14,1540 1640 E=-4 2-1.73205 2-1 2+0 2+1 2+1.73205 4
K=(13 10 5 1,) 1/50 3/47

L18 DEG=4 F=I AUT=4 P=(1,22,14,2) GIR=3 CN=3,4
A=1 1 1 11,6 24 22 114 212,1440 2340 E=2-3 4-1 0 2+1 2+2 4 K=(12 6,1)
-D(L21) B2XF6 C2XD3 1/30 2/25 3/501 5/14

L19 DEG=4 F=I AUT=12 P=(1,13,23,2) GIR=4 CN=2,6
A=1 1 1 1,34 34 12 22 6,1700 1640 E=-4 -2 4-1 4+1 2 4 K=(13 10 5 1,) B2XF5
2/16 3/214

L20 DEG=4 F=IAP AUT=4 P=(1,4,24,1) GIR=3 CN=3,4 T=1 CUBOCTAHEDRON
A=1 1 5 3,30 6 50 304 60,1102 3600 E=5-2 3+0 3+2 4 K=(11 3,2) L(H7) -D(L10)
4/50

L21 DEG=4 F=IP AUT=2 P=(1,22,22,12) GIR=3 CN=3,4 ANTIPRISM
A=1 1 3 15,12 24 104 42 600,1440 3300 E=4-2 2-.73205 3+0 2+2.73205 4
K=(10 1,3) -D(L12) 1/44 3/205

L22 DEG=4 F=IA AUT=2 P=(1,22,222,1) GIR=3 CN=3,4
A=1 1 1 11,24 12 4 202 454,322 740 E=2-2.73205 2-2 3+0 2+.73205 2+2 4
K=(12 5,1) 1/22 3/403

L23 DEG=4 F=I AUT=64 P=(1,4,14,2) GIR=4 CN=2,6 T=1
A=1 1 1 1,36 30 30 6 6,1700 1700 E=-4 2-2 6+0 2+2 4 K=(13 11 5 1,) F4[B1]
B2*F7 C2*D3 1/42 2/110 3/221 5/24

L24 DEG=4 F=I AUT=4 P=(1,22,124) GIR=4 CN=3,6
A=1 1 1 1,6 60 50 224 222,1114 512 E=2-3 2-2 0 6+1 4 K=(13 6,) D(L13) 1/14
2/43 3/132 5/42

L25 DEG=5 F=XTI AUT=86400 P=(1,5,+) GIR=3 CN=6,2 T=2
A=1 3 7 17,37 0 100 300 700,1700 3700 2[F8] SW(F3) SW(F8) D2[C2] F3[B2] 1/25
2/121 3/610 5/13

L26 DEG=5 F=I AUT=64 P=(1,14,4,2) GIR=3 CN=4,3
A=1 3 7 3,23 60 160 14 414,1700 3700 E=-3 8-1 2+3 5 K=(4,6 2) SW(F2) SW(F4)
-D(L18) -D(L35) F4[B2] 1/43 2/114 3/245 5/61

L27 DEG=5 AUT=1 P=(1/5/6) GIR=3 CN=3,4
A=1 1 1 15,11 50 66 306 412,1160 3106 E=-3 2-2.73205 2-1 2+0 2+.73205 2+2 5
K=(7 1,3) 3/225

L28 DEG=5 F=I AUT=2 P=(1,122,222) GIR=3 CN=3,4
A=1 1 5 1,1 50 124 252 526,272 166 E=2-3.73205 2-1 2-.26795 5+1 5 K=(9 4,1)
D(L22) 1/61 3/413

L29 DEG=5 F=I AUT=2 P=(1,122,222) GIR=3 CN=4,3
A=1 3 7 1,1 22 42 170 264,1350 724 E=-3 2-2.73205 2-1 2+0 2+.73205 2+2 5
K=(7,3 1) 1/13 3/174

TRANSITIVE GRAPHS ON 12 VERTICES (CONTD)

L30 DEG=5 F=I AUT=12 P=(1,23,6) GIR=3 CN=4,3
A=1 3 1 11,31 44 12 314 222,1524 1342 E=6-2 3+1 2+2 5 K=(6,4 1) C2XD4 -C2*D4
1/31 2/27 3/434 4/17 5/31

L31 DEG=5 AUT=1 P=(1/5/6) GIR=3 CN=3,4
A=1 1 1 15,15 74 42 210 702,622 3406 E=2-2.73205 2-2 -1 2+0 2+.73205 1 3 5
K=(6 1,4) 3/503

L32 DEG=5 F=I AUT=4 P=(1,122,24) GIR=3 CN=4,3
A=1 1 1 3,23 16 16 250 144,1630 1524 E=2-3 2-2 4+0 1 2+2 5 K=(7,3 1) 1/15
2/17 3/311 5/23

L33 DEG=5 F=I AUT=4 P=(1,14,24) GIR=3 CN=4,4
A=1 1 1 11,5 50 124 262 162,1216 516 E=3-3 2-1 6+1 5 K=(8 2,2) -L(F7) D(L20)
4/111

L34 DEG=5 F=TIA AUT=120 P=(1,5,5,1) GIR=4 CN=2,6 T=2
A=1 1 1 1,1 74 72 66 56,36 3700 E=-5 5-1 5+1 5 K=(10 10 5 1,) SW(F1) SW(F5)
-W6(B2) -B2XF8 B2*F8 2/111 3/163

L35 DEG=5 F=IA AUT=8 P=(1,14,14,1) GIR=3 CN=3,4
A=1 1 1 15,15 74 42 206 212,1422 3700 E=2-3 5-1 3+1 3 5 K=(6 2,4) SW(F6)
SW(F7) -D(L15) B2XF7 2/124 3/416

L36 DEG=5 F=I AUT=2 P=(1,122,222) GIR=3 CN=4,4
A=1 1 1 5,31 50 124 216 116,642 3122 E=2-3 2-1.73205 2-1 3+1 2+1.73205 5
K=(7,3) 1/7 3/350

L37 DEG=5 F=TIAP AUT=10 P=(1,5,5,1) GIR=3 CN=4,4 T=1 ICOSAHEDRON
A=1 3 5 3,31 50 114 22 560,606 3700 E=3-2.23607 5-1 3+2.23607 5 K=(5,5)
SW(E2+) -D(L37) 4/121

TRANSITIVE GRAPHS ON 13 VERTICES

M1 DEG=0 F=XTVIAP AUT=479001600 P=(1,+) CN=1,13

M2 DEG=2 F=TVIP AUT=2 P=(1,2,2,2,2,2,2) GIR=13 CN=3,7 POLYGON
A=1 1 4 2,20 10 100 40 400,200 2000 5000
E=2-1.94188 2-1.49702 2-.70921 2+.24107 2+1.13613 2+1.77091 2 K=(36 56 35 6,)
1/1

M3 DEG=4 F=VI AUT=4 P=(1,4,44) GIR=4 CN=4,7 T=1
A=1 1 1 1,20 10 142 144 54,1122 224 4412 E=4-2.65109 4+.27389 4+1.37720 4
K=(18 12,) 1/6

M4 DEG=4 F=VI AUT=2 P=(1,22,22,22) GIR=3 CN=4,5
A=1 1 3 15,24 12 44 102 400,1200 3500 3240
E=2-2.20623 2-1.70081 2-1.25595 2-.17097 2+.42692 2+2.90704 4 K=(15 4,3)
D(M2) 1/44

M5 DEG=4 F=VI AUT=2 P=(1,22,222,2) GIR=4 CN=3,7
A=1 1 1 1,34 32 4 202 414,222 2500 5240
E=2-3.43891 2-.80575 2-.46814 2-.36089 2+1.06170 2+2.01199 4 K=(18 16 5,)
-D(M4) 1/5

M6 DEG=6 F=TVIS AUT=6 P=(1,6,6) GIR=3 CN=5,5 T=1
A=1 3 1 15,11 43 124 312 432,654 3046 5360 E=6-2.30278 6+1.30278 6 K=(6,6)
1/15

M7 DEG=6 F=VIS AUT=2 P=(1,222,222) GIR=3 CN=5,5
A=1 3 3 15,5 3 132 74 244,1502 3350 3560
E=2-3.19783 2-1.96516 2-1.07010 2+.07010 2+.96516 2+2.19783 6 K=(6,6) 1/64

M8 DEG=6 F=VI AUT=2 P=(1,222,222) GIR=3 CN=4,5
A=1 3 5 3,1 1 174 172 164,1152 2524 5252
E=2-4.14811 2-.88018 2-.56468 2+.51496 2+.66799 2+1.41002 6 K=(9 4,3) -M9
D(M5) 1/16

M9 DEG=6 F=VI AUT=2 P=(1,222,222) GIR=3 CN=5,4
A=1 1 3 5,33 75 124 52 412,1224 3604 7602
E=2-2.41002 2-1.66799 2-1.51496 2-.43532 2-.11982 2+3.14811 6 K=(3,9 4) -M8
-D(M5) 1/52

TRANSITIVE GRAPHS ON 14 VERTICES

N1 DEG=0 F=XTVIAP AUT=6227020800 P=(1,+) CN=1,14

N2 DEG=1 F=XTIP AUT=46080 P=(1,1,+) CN=2,7 T=1
A=1 0 4 0,20 0 100 0 400,0 2000 0 10000

N3 DEG=2 F=XTIP AUT=28 P=(1,2,2,2,+) GIR=7 CN=3,8
A=1 1 4 2,20 50 0 200 0,0 2400 1200 3000 2[G2] 1/20 2/200

N4 DEG=2 F=TIAP AUT=2 P=(1,2,2,2,2,2,2,1) GIR=14 CN=2,7 POLYGON
A=1 1 4 2,20 10 100 40 400,200 2000 1000 14000
E=-2 2-1.80194 2-1.24698 2-.44504 2+.44504 2+1.24698 2+1.80194 2
K=(45 84 70 21 1,) B2*G2 1/2 2/140

N5 DEG=3 F=I AUT=2 P=(1,12,22,22,2) GIR=4 CN=2,7
A=1 1 1 12,6 10 4 200 100,240 120 3400 5400
E=-3 2-2.24698 2-.80194 2-.55496 2+.55496 2+.80194 2+2.24698 3
K=(33 44 25 6 1,) D(N4) 1/11 2/7

N6 DEG=3 F=IP AUT=2 P=(1,12,22,22,2) GIR=4 CN=3,7 PRISM
A=1 1 1 12,6 10 4 200 500,240 120 5000 12400
E=2-2.80194 2-1.44504 2-.80194 2+.24698 2+.55496 1 2+2.24698 3 K=(33 44 25 6,)
B2XG2 1/5 2/201

N7 DEG=3 F=TI AUT=24 P=(1,3,6,4) GIR=6 CN=2,7 T=4 HEAWOOD GRAPH
A=1 1 1 10,2 2 4 4 10,1240 1500 460 320 E=-3 6-1.41421 6+1.41421 3
K=(33 42 20 6 1,) 2/144

N8 DEG=4 F=XI AUT=28 P=(1,22,2,+) GIR=3 CN=4,6
A=1 3 5 3,34 72 0 200 200,400 3400 3600 7200 2[G3] 1/104 2/1200

N9 DEG=4 F=IAP AUT=2 P=(1,22,22,22,1) GIR=3 CN=4,5 ANTIPRISM
A=1 1 3 15,24 12 44 102 500,240 1400 6200 17000
E=2-2.24698 2-1.69202 2-1.35690 2-.55496 0 2+.80194 2+3.04892 4 K=(21 10,3)
1/60 2/504

N10 DEG=4 F=I AUT=2 P=(1,22,222,12) GIR=4 CN=2,7
A=1 1 1 1,32 34 14 22 2,4 3600 3300 3440
E=-4 2-2.24698 2-.80194 2-.55496 2+.55496 2+.80194 2+2.24698 4
K=(24 26 15 6 1,) B2*G3 1/12 2/164

N11 DEG=4 F=IA AUT=2 P=(1,22,2222,1) GIR=4 CN=3,7
A=1 1 1 1,24 12 4 2 414,1222 450 4320 740
E=2-3.04892 2-2.24698 2-.55496 0 2+.80194 2+1.35690 2+1.69202 4 K=(24 22 5,)
1/22 2/214

N12 DEG=4 F=I AUT=128 P=(1,4,14,4) GIR=4 CN=3,7 T=1
A=1 1 1 1,36 30 6 6 30,600 3100 4600 13100 E=2-3.60388 2-.89008 7+0 2+2.49396 4
K=(24 28 15 3,) -D(N14) G2[B1] 1/30 2/1005

N13 DEG=4 F=TI AUT=24 P=(1,4,6,3) GIR=4 CN=2,7 T=2 DUAL OF HEAWOOD
A=1 1 1 1,30 24 14 12 6,22 2700 3240 1540 E=-4 6-1.41421 6+1.41421 4
K=(24 24 15 6 1,) 2/154

N14 DEG=5 F=I AUT=128 P=(1,14,4,4) GIR=3 CN=5,4
A=1 3 7 3,23 14 60 114 260,1200 2500 7200 16500
E=2-2.60388 7-1 2+.10992 2+3.49396 5 K=(12,6 2) -D(N12) G2[B2] 1/31 2/207

N15 DEG=5 F=I AUT=2 P=(1,122,2222) GIR=3 CN=4,5
A=1 1 5 5,11 50 24 242 122,1006 2412 3340 4720
E=2-2.69202 2-2.35690 2-1.24698 -1 2+.44504 2+1.80194 2+2.04892 5 K=(15 4,3)
D(N6) D(N9) 1/61 2/1114

N16 DEG=5 F=A AUT=1 P=(1/5/7/1) GIR=3 CN=4,5
A=1 1 1 11,15 60 6 202 530,406 710 2066 7300
E=2-3.21615 2-1.85926 -1 2-.38772 2-.16723 2+.96917 2+2.66119 5 K=(15 8,3)
2/226

N17 DEG=5 F=I AUT=2 P=(1,122,222,2) GIR=3 CN=4,5
A=1 1 5 11,5 70 164 12 406,1042 422 7200 16500
E=2-3.24698 2-1.55496 2-1.24698 2-.19806 2+.44504 2+1.80194 3 5 K=(15 8,3)
B2XG3 1/105 2/1201

N18 DEG=5 F=I AUT=2 P=(1,122,2222) GIR=4 CN=3,7
A=1 1 1 1,1 66 72 52 26,1110 2604 5050 12424
E=2-4.04892 2-1.24698 -1 2+.35690 2+.44504 2+.69202 2+1.80194 5 K=(18 16 5,)
D(N11) D(N5) 1/23 2/541

TRANSITIVE GRAPHS ON 14 VERTICES (CONTD)

N19 DEG=5 F=I AUT=2 P=(1,122,222,2) GIR=4 CN=2,7
A=1 1 1 1,1 72 66 54 34,26 52 7500 7600
E=-5 2-1.80194 2-1.24698 2-.44504 2+.44504 2+1.24698 2+1.80194 5
K=(18 20 15 6 1,) 1/13 2/172

N20 DEG=6 F=XTI AUT=3628800 P=(1,6,+) GIR=3 CN=7,2 T=2
A=1 3 7 17,37 77 0 200 600,1600 3600 7600 17600 2[G4] SW(G4) 1/124 2/1600

N21 DEG=6 AUT=1 P=(1/6/7) GIR=3 CN=5,4
A=1 1 1 11,5 75 70 46 422,630 1456 3302 13206
E=2-3.21615 -2 2-1.85926 2-.38772 2-.16723 2+.96917 2+2.66119 6 K=(9,6 2)
2/233

N22 DEG=6 F=I AUT=2 P=(1,222,1222) GIR=3 CN=4,5
A=1 3 1 1,5 3 170 164 552,1224 2612 4134 12072
E=2-4.04892 2-1.80194 2-.44504 2+.35690 2+.69202 2+1.24698 2 6 K=(12 6,3)
1/122 2/1206

N23 DEG=6 F=I AUT=2 P=(1,222,1222) GIR=3 CN=4,5
A=1 3 5 3,1 1 170 164 152,1304 2642 5134 2472
E=2-4.04892 -2 2-1.24698 2+.35690 2+.44504 2+.69202 2+1.80194 6 K=(12 6,3)
D(N16) 1/46 2/1017

N24 DEG=6 F=TIA AUT=720 P=(1,6,6,1) GIR=4 CN=2,7 T=2
A=1 1 1 1,1 1 174 172 166,156 136 76 17600 E=-6 6-1 6+1 6 K=(15 20 15 6 1,)
SW(G1) -W7(B2) -B2XG4 B2*G4 1/52 2/173

N25 DEG=6 F=I AUT=2 P=(1,222,1222) GIR=3 CN=4,5
A=1 3 1 11,15 23 36 214 222,544 3142 5450 13520
E=2-2.69202 2-2.35690 2-1.80194 2-.44504 2+1.24698 2 2+2.04892 6 K=(9 2,6)
1/106 2/1203

N26 DEG=6 F=I AUT=2 P=(1,222,1222) GIR=3 CN=4,5
A=1 1 3 5,15 23 36 214 222,544 3142 5450 13520
E=2-2.69202 2-2.35690 -2 2-1.24698 2+.44504 2+1.80194 2+2.04892 6 K=(9 2,6)
1/54 2/570

N27 DEG=6 F=IA AUT=2 P=(1,222,222,1) GIR=3 CN=4,5
A=1 3 3 15,5 3 132 74 144,1142 2310 5460 17600
E=2-3.49396 6-1 2-.10992 2 2+2.60388 6 K=(9 4,6) SW(G3) -D(N28) 1/160 2/1214

N28 DEG=6 F=IA AUT=2 P=(1,222,222,1) GIR=3 CN=5,4
A=1 1 3 5,33 75 124 52 412,224 3204 7402 17600
E=2-2.60388 -2 6-1 2+.10992 2+3.49396 6 K=(6,9 4) SW(G2) -D(N17) -D(N27) 1/16
2/1055

TRANSITIVE GRAPHS ON 15 VERTICES

O1 DEG=0 F=XTVIAP P=(1,+) CN=1,15

O2 DEG=2 F=XTIP AUT=62208 P=(1,2,+) GIR=3 CN=3,5
A=1 3 0 10,0 30 40 0 240,400 0 2400 4000 24000 5[C2] 1/20

O3 DEG=2 F=XTIP AUT=400 P=(1,2,2,+) GIR=5 CN=3,9
A=1 1 4 12,0 40 0 0 500,440 200 0 14000 10200 3[E2] 1/40

O4 DEG=2 F=TIP AUT=2 P=(1,2,2,2,2,2,2,2) GIR=15 CN=3,8 POLYGON
A=1 1 4 2,20 10 100 40 400,200 2000 1000 10000 24000
E=2-1.95630 2-1.61803 2-1 2-.20906 2+.61803 2+1.33826 2+1.82709 2
K=(55 120 126 56 7,) 1/2

O5 DEG=4 F=XTI AUT=691200 P=(1,4,+) GIR=3 CN=5,3 T=2
A=1 3 7 17,0 40 0 140 540,1540 200 4200 14200 34200 3[E3] 1/44

O6 DEG=4 F=I AUT=4 P=(1,22,24,4) GIR=3 CN=3,5
A=1 1 1 11,4 42 24 22 214,412 500 1040 14240 16100
E=4-2.61803 4-.38197 2+.38197 2+1 2+2.61803 4 K=(30 32 10,1) C2XE2 1/60

O7 DEG=4 F=NTIA AUT=8 P=(1,4,8,2) GIR=3 CN=4,6 T=1
A=1 3 1 11,20 4 110 144 2,210 1060 3002 5300 12440 E=5-2 4-1 5+2 4
K=(29 24 2,2) L(J7)

TRANSITIVE GRAPHS ON 15 VERTICES (CONTD)

08 DEG=4 F=I AUT=2 P=(1,22,22,22,2) GIR=3 CN=3,5
A=1 1 3 15,24 12 44 102 400,200 1500 2240 7000 33000
E=2-2.16535 2-2 4-1 2-.12920 2+1.12920 2+3.16535 4 K=(28 20 1,3) D(04) 1/12

09 DEG=4 F=I AUT=2 P=(1,22,2222,2) GIR=4 CN=3,8
A=1 1 1 1,24 12 4 2 414,1222 410 4220 10540 4340
E=2-3.23607 2-1.82709 2-1.33826 2+.20906 2+1 2+1.23607 2+1.95630 4
K=(31 36 15 2,) 1/104

010 DEG=4 F=I AUT=2 P=(1,22,222,22) GIR=3 CN=3,5
A=1 1 1 11,24 12 54 122 2,4 3040 3100 11400 26200
E=2-2.95630 2-2 2-1.20906 2+.33826 2+.38197 2+.82709 2+2.61803 4 K=(30 32 11,1)
1/22

011 DEG=4 F=I AUT=2 P=(1,22,222,22) GIR=4 CN=3,8
A=1 1 1 1,34 32 4 202 14,22 2400 5200 12500 5240
E=2-3.57433 4-1 2-.27977 2+.40898 2+1 2+2.44512 4 K=(31 40 25 6,) 1/140

012 DEG=4 F=I AUT=4 P=(1,4,224,2) GIR=4 CN=3,8 T=1
A=1 1 1 1,24 12 30 6 120,50 1042 2104 6600 11600
E=2-3.23607 2-2 4-.61803 2+1.23607 4+1.61803 4 K=(31 36 16 2,) C2*E2 1/11

013 DEG=6 F=I AUT=2 P=(1,222,2222) GIR=3 CN=5,3
A=1 3 7 17,1 1 50 320 344,542 2510 1260 16504 15242
E=2-2.95630 2-2.61803 2-1.20906 2-.38197 2+.33826 2+.82709 2+3 6 K=(13,6 4 1)
1Fj44

014 DEG=6 F=I AUT=2 P=(1,222,2222) GIR=3 CN=3,5
A=1 3 5 3,1 41 134 72 104,42 3464 3312 3260 23510
E=2-3.16535 2-3 2-1.12920 2+.12920 4+1 2+2.16535 6 K=(15 8 1,4) 1/121

015 DEG=6 F=I AUT=2 P=(1,222,2222) GIR=3 CN=4,5
A=1 3 1 1,5 3 72 334 64,1112 2224 1412 16160 15150
E=2-3.78339 2-2.61803 2-.38197 2+0 2+.48883 2+1.54732 2+1.74724 6 K=(16 8,3)
1/16

016 DEG=6 F=I AUT=4 P=(1,24,224) GIR=3 CN=3,5
A=1 3 5 13,5 43 146 36 30,140 3300 3420 17410 17240
E=2-3 4-1.61803 2-1.23607 4+.61803 2+3.23607 6 K=(12 4 1,7) 1/122

017 DEG=6 F=I AUT=2 P=(1,222,222,2) GIR=3 CN=5,4
A=1 1 3 5,33 75 124 52 204,1402 2412 1224 17200 37400
E=2-2.61803 2-1.74724 2-1.54732 2-.48883 2-.38197 2+0 2+3.78339 6 K=(10,9 4)
-D(010) -D(011) 1/52

018 DEG=6 F=I AUT=2 P=(1,222,2222) GIR=3 CN=4,5
A=1 1 3 5,23 55 164 152 204,402 3220 7410 13012 27024
E=2-2.82709 2-2.33826 2-1.23607 2-.79094 2+0 2+.95630 2+3.23607 6 K=(12 4,7)
-D(017) 1/124

019 DEG=6 F=I AUT=2 P=(1,222,2222) GIR=3 CN=3,5
A=1 1 1 11,23 55 134 72 42,104 3404 7202 13214 7422
E=2-3 2-2.61803 2-.82709 2-.38197 2-.33826 2+1.20906 2+2.95630 6 K=(13 4 1,6)
D(08) 1/13

020 DEG=6 F=I AUT=48 P=(1,24,8) GIR=3 CN=5,3
A=1 3 1 11,31 71 104 12 614,422 3224 2442 15244 12702 E=8-2 4+1 2+3 6
K=(12,7 4 1) C2XE3 -C2*E3 1/64

021 DEG=6 F=NTVI AUT=48 P=(1,6,8) GIR=3 CN=4,5 T=1
A=1 3 1 1,21 11 124 142 654,54 2342 2524 15032 2632 E=5-3 9+1 6 K=(16 8 2,3)
-L(F8) D(07)

022 DEG=6 F=I AUT=2 P=(1,222,2222) GIR=3 CN=3,5
A=1 3 1 1,1 1 174 172 424,1212 2124 5052 12164 5152
E=2-4.57433 2-1.27977 2-.59102 2+0 4+1 2+1.44512 6 K=(18 16 5,1) 1/62

023 DEG=6 F=I AUT=5184 P=(1,6,26) GIR=4 CN=3,8 T=1
A=1 1 1 1,1 1 176 176 160,1016 1016 1016 16160 16160
E=2-4.85410 10+0 2+1.85410 6 K=(19 20 10 2,) D(012) D(09) E2[C1] 1/51

024 DEG=6 F=I AUT=4 P=(1,24,224) GIR=3 CN=4,6
A=1 1 5 13,5 43 2 204 740,630 1262 1514 6464 12312
E=2-2.61803 4-2.23607 2-.38197 2+0 4+2.23607 6 K=(13 4,6) -D(06) 1/15

5. Additional Information. (a) Two graphs are *cospectral* if their adjacency matrices have the same eigenvalues and multiplicities. We list here all families of cospectral graphs in the catalogue. The complements of each member of a family form another family.

12 vertices:	L15	L21	L27	L29.					
16 vertices:	P33	P49,	P35	P45,	P61	P88,	P63	P72,	
	P64	P86,	P75	P91,	P78	P95,	P81	P84,	
	P97	P107,	P98	P134,	P99	P113	P118,	P103	P108,
	P105	P141,	P111	P112,	P120	P136,	P124	P137,	
	P142	P143.							

(b) The following graphs are the only ones in the catalogue which are not Cayley graphs:

J7, O7, O21, P20, P52, P93, P110, R38, R147.

(c) The switching classes of transitive graphs of even order are shown in Table 3. It is easy to show that X and Y are switching equivalent if and only if $\bar{X}$ and $\bar{Y}$ are. Thus each family in Table 3 provides another by complementing each member. However the following graphs are actually switching equivalent to their own complements:

B1, J3, J6, J7, R15, R32, R38, R39, R147, R148, R161, R179.

Table 3 does not include the following graphs, as they are unique in their switching classes: L10, L16, L37, P74 and P139. It may be worth noticing that each family of cospectral graphs is related also by switching. In fact, two switching equivalent regular graphs of the same degree are necessarily cospectral.

(d) The self-complementary transitive graphs in the catalogue are E2, I4, M6, M7, Q14, Q15, Q18 and Q20.

(e) The connected planar transitive graphs (excluding polygons) with order less than 20 are D4, F6, F7, H7, H10, J6, J11, L10, L13, L20, L21, L37, N6, N9, P10, P16, R10 and R20.

(f) The distance-regular connected graphs in the catalogue, excluding polygons and those with $d > (n - 1)/2$, are H7, I4, J7, J10, L34, L37, M6, N7, N13, N24, O7, O21, P27, P55, P81, P84, P130, Q18, R11 and R173. Of these, only P84 is not distance-transitive.

(g) Aut(X) will act primitively on $V(X)$ if n is prime or if X has no edges. Excluding complements, the only other examples in the catalogue where this occurs are for I4, J7, O21, P55 and P81.

(h) The following are all those graphs in the catalogue whose arc-transitivity is at least one. We exclude disconnected graphs, polygons, and those whose complements are a disjoint union of complete graphs.

H7, I4, J7, J9, J10, $\overline{\text{J7}}$, L20, L23, L34, L37, $\overline{\text{L30}}$, M3, M6, N7, N12, N13, N24, O7, O12, O21, O23, $\overline{\text{O20}}$, $\overline{\text{O21}}$, P12, P23, P27, P55, P81, P82, P84, P130, $\overline{\text{P55}}$, $\overline{\text{P81}}$, Q3, Q18, R11, R28, R29, R88, R90, R171, R173, $\overline{\text{R126}}$, S14.

(i) The only connected graph in the catalogue which has no Hamiltonian cycle is Petersen's graph (J7), which has Hamiltonian paths and cycles of length 9.

B1	-B1 .								
D1	-D2 .								
F1	-F3 ,	F2	F4 .						
H1	-H5 ,	H2	-H3	H7 ,	H4	-H6 .			
J1	-J8 ,	J2	J10 ,	J3	-J3 ,	J4	J5 ,		
J6	-J6 ,	J7	-J7 ,	J9	-J11 .				
L1	-L25 ,	L2	-L14	L34 ,	L3	-L8 ,	L4	L23	-L35 ,
L5	-L9	L19 ,	L6	L17	-L31 ,	L7	L26 ,		
L11	-L22	L36 ,	L12	L27	L29 ,	L13	-L18	L32 ,	
L15	L21	-L28 ,	L20	-L33 ,	L24	-L30 .			
N1	-N20 ,	N2	N24 ,	N3	-N8 ,	N4	N19 ,	N5	N10 ,
N6	-N17 ,	N7	N13 ,	N9	-N22 ,	N11	-N25 ,	N12	-N27 ,
N14	N28 ,	N15	N26 ,	N16	N21 ,	N18	N23 .		
P1	-P96 ,	P2	-P56	P130,	P3	-P29	P82	-P132,	
P4	-P30	P87	-P116,	P5	P69	-P114,	P6	-P13	P109,
P7	-P14	P48	-P89	P140,	P8	-P15	-P76	P133,	
P9	-P62	P127,	P10	P40	-P63	-P72	P105	P141,	
P11	P37	-P64	-P86	P124	P137,				
P12	P39	-P71	P106,	P16	P83	-P131,			
P17	-P32	-P125,	P18	P80	-P101,	P19	-P123,		
P20	-P52	P93	-P110,	P21	-P33	-P49	P57	-P103	-P108,
P22	-P53	P61	P88	-P120	-P136,	P23	-P111	-P112,	
P24	-P35	-P45	P78	P95	-P99	-P113	-P118,		
P25	-P47	P90	-P121,	P26	-P41	P68 ,			
P27	-P44	P94	-P97	-P107,	P28	-P54	P58	-P104,	
P31	-P70	P138,	P34	P128,	P36	-P85	P102,		
P38	P100,	P42	-P66	P117,	P43	-P67	P98	P134,	
P46	-P59	P142	P143,	P50	-P75	-P91	P129,		
P51	-P65 ,	P55	-P81	-P84 ,	P60	-P135,	P73	-P122,	
P77	-P115,	P79	-P119,	P92	-P126 .				
R1	-R137,	R2	R173,	R3	-R54 ,	R4	R113,	R5	-R55 ,
R6	R130,	R7	R90 ,	R8	-R132,	R9	R85 ,	R10	-R111,
R11	R88 ,	R12	-R103,	R13	R80 ,	R14	-R172,	R15	-R15 ,
R16	-R17 ,	R18	R33 ,	R19	R37 ,	R20	-R153,	R21	-R166,
R22	R49 ,	R23	-R141,	R24	R40 ,	R25	-R151,	R26	-R165,
R27	-R156,	R28	-R158,	R29	R48 ,	R30	R139,	R31	R180,
R32	-R32 ,	R34	R178,	R35	-R36 ,	R38	-R38 ,	R39	-R39 ,
R41	R159,	R42	R157,	R43	R140,	R44	R167,	R45	R182,
R46	R144,	R47	R189,	R50	R154,	R51	R187,	R52	R168,
R53	R181,	R56	R93 ,	R57	R94 ,	R58	R109,	R59	-R74 ,
R60	R114,	R61	R110,	R62	-R83 ,	R63	-R84 ,	R64	R96 ,
R65	-R86 ,	R66	R119,	R67	R107,	R68	R106,	R69	-R75 ,
R70	R102,	R71	-R76 ,	R72	R124,	R73	R133,	R77	R95 ,
R78	R121,	R79	R108,	R81	R127,	R82	R131,	R87	R116,
R89	R97 ,	R91	R128,	R92	-R136,	R98	-R120,	R99	-R125,
R100	-R117,	R101	-R104,	R105	-R115,	R112	-R123,	R118	-R129,
R122	-R134,	R126	-R135,	R138	-R142,	R143	-R150,	R145	-R149,
R146	-R163,	R147	-R147,	R148	-R148,	R152	-R174,	R155	-R160,
R161	-R161,	R162	-R170,	R164	-R183,	R169	-R184,	R171	-R186,
R175	-R190,	R176	-R177,	R179	-R179,	R185	-R188 .		

TABLE 3. *Switching classes of transitive graphs (– X is the complement of X)*

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