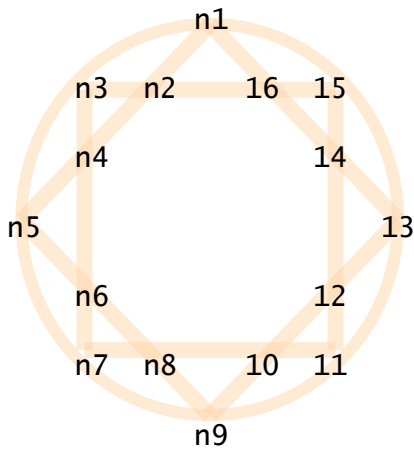


# Part 2: Basic Studies of Magic Stars II: Kanji Setsuda

## Chapter 5: Algebraic Study of Double-Ringed Magic Stars 8

Let's study about Double-Ringed type of Magic Stars of order 8 next.

Two more numerical elements and one more simultaneous equation are added to the case of order 7. What do they new comers give to our object?



\* Basic Definition \*

$$\begin{aligned} n1+n2+n4+n5 &= C & \dots & r1 \\ n3+n4+n6+n7 &= C & \dots & r2 \\ n5+n6+n8+n9 &= C & \dots & r3 \\ n7+n8+n10+n11 &= C & \dots & r4 \\ n9+n10+n12+n13 &= C & \dots & r5 \\ n11+n12+n14+n15 &= C & \dots & r6 \\ n13+n14+n16+n1 &= C & \dots & r7 \\ n15+n16+n2+n3 &= C & \dots & r8 \end{aligned}$$

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$$\begin{aligned} 2*(n1+n2+n3+\dots+n15+n16) &= 8*C \\ 2*136 &= 8*C \end{aligned}$$

Therefore C=34 ... r1

First of all, I dictated a program and made my computer calculate and list out all the standard solutions of magic star of order 8. The next list shows the recent result.

\*\*\* Composing Magic Stars of Order 8 \*\*\*

\*\* Collective List of Standard Solutions: \*\*

[ Type n1=1: ]

1#

```

      1
    3 15 10 6
  16          9
2          14
  11          7
  4 13 5 12
      8
  
```

2#

```

      1
    4 15 12 3
  16          14
2          7
  9          6
  5 10 8 11
      13
  
```

3#

```

      1
    6 15 10 3
  16          14
2          9
  8          5
  4 11 7 12
      13
  
```

4#

```

      1
    4 16 9 5
  15          11
2          13
  12          8
  3 14 7 10
      6
  
```

5#

```

      1
    4 16 11 3
  15          13
2          9
  8          6
  7 10 5 12
      14
  
```

6#

```

      1
    2 16 11 5
  14          13
3          9
  10          12
  8 15 7 4
      6
  
```

7#

```

      1
    2 14 8 10
  15          16
4          9
  11          5
  6 12 13 3
      7
  
```

8#

```

      1
    6 14 9 5
  15          11
4          13
  10          2
  3 8 7 16
      12
  
```

9#

```

      1
    5 16 11 2
  13          12
4          10
  7          6
  9 8 3 14
      15
  
```

10#

1  
 6 16 10 2  
 13 9  
 4 12 14 8  
 3 11 5 15  
 7

11#

1  
 3 12 15 4  
 16 7  
 5 13 11 9  
 2 10 8 14  
 6

12#

1  
 3 12 15 4  
 16 10  
 5 13 6 8  
 2 7 11 14  
 9

13#

1  
 2 13 10 9  
 15 7  
 5 14 16 6  
 3 11 8 12  
 4

14#

1  
 3 16 13 2  
 12 11  
 5 15 9 7  
 4 6 10 14  
 8

15#

1  
 3 16 11 4  
 12 15  
 5 9 13 7  
 10 14 8 2  
 6

16#

1  
 7 14 8 5  
 13 16  
 6 2 10 9  
 12 15 4 3  
 11

17#

1  
 4 14 13 3  
 12 9  
 7 10 16 11  
 8 15 5 6  
 2

18#

1  
 4 16 12 2  
 10 13  
 7 9 5 8  
 11 3 6 14  
 15

19#

1  
 10 9 12 3  
 16 7  
 8 6 14 119  
 2 15 4 13  
 5

20#

1  
 2 12 15 5  
 13 7  
 8 16 11 13  
 10 14 4 6  
 3

21#

1  
 5 15 3 11  
 10 14  
 8 2 16  
 6 9 12 7  
 4

22#

1  
 9 15 3 7  
 10 16  
 8 11 14 6  
 4 13 12 5  
 2

23#

1  
 3 16 10 5  
 9 119  
 8 7 12 14  
 15 13 2 4  
 6

24#

1  
 5 16 11 2  
 12  
 8 7 10  
 13 4 3 14  
 15

25#

1  
 2 8 13 11  
 16 5  
 9 6 15 4  
 10 7 3 14  
 12

26#

1  
 5 8 14 7  
 16 4  
 9 10 15 11  
 3 13 6 12  
 2

27#

1  
 11 10 5 8  
 14 16  
 9 7 12  
 2 15 13 4  
 3

28#

1  
 3 11 14 6  
 13 7  
 9 8 12 16  
 10 15 4 5  
 2

29#

1  
 3 11 16 4  
 13 7  
 9 6 10 8  
 12 5 2 15  
 14

30#

1  
 4 7 8 15  
 16 11  
 10 2 14  
 12 13 6 3  
 9

<p>31#</p> <p>14 11 1 4 5</p> <p>12 13</p> <p>10 6 7 16</p> <p>2 15 8 9</p> <p>3</p>	<p>32#</p> <p>4 14 1 5 11</p> <p>9 12</p> <p>10 15 3 16</p> <p>6 7 13 8</p> <p>2</p>	<p>33#</p> <p>11 14 1 5 4</p> <p>9 15</p> <p>10 6 12 13</p> <p>8 16 7 3</p> <p>2</p>
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<p>37#</p> <p>4 15 1 10 5</p> <p>6 9</p> <p>12 8 7 14</p> <p>16 3 2 13</p> <p>11</p>	<p>38#</p> <p>4 5 1 16 9</p> <p>15 3</p> <p>13 8 12 14</p> <p>7 11 6 10</p> <p>2</p>	<p>39#</p> <p>5 9 1 16 4</p> <p>11 3</p> <p>13 8 12 14</p> <p>10 7 2 15</p> <p>6</p>
<p>40#</p> <p>5 11 1 10 8</p> <p>9 7</p> <p>13 6 4 16</p> <p>14 3 2 15</p> <p>12</p>	<p>41#</p> <p>4 15 1 8 7</p> <p>5 11</p> <p>13 16 6 14</p> <p>9 3 12 10</p> <p>2</p>	<p>42#</p> <p>10 15 1 3 6</p> <p>5 14</p> <p>13 8 2 16</p> <p>11 4 7 12</p> <p>9</p>
<p>43#</p> <p>6 3 1 13 12</p> <p>16 5</p> <p>14 2 8 15</p> <p>10 11 4 9</p> <p>7</p>	<p>44#</p> <p>15 8 1 4 7</p> <p>11 13</p> <p>14 5 2 16</p> <p>3 9 10 12</p> <p>6</p>	<p>45#</p> <p>8 10 1 4 12</p> <p>9 13</p> <p>14 2 6 16</p> <p>15 11 5 3</p> <p>7</p>
<p>46#</p> <p>5 13 1 7 9</p> <p>6 10</p> <p>14 15 4 16</p> <p>8 3 12 11</p> <p>2</p>	<p>47#</p> <p>9 16 1 7 2</p> <p>3 11</p> <p>14 10 8 15</p> <p>12 4 5 13</p> <p>6</p>	<p>48#</p> <p>6 13 1 7 8</p> <p>5 10</p> <p>15 14 4 16</p> <p>9 2 11 12</p> <p>3</p>
<p>49#</p> <p>9 14 1 5 6</p> <p>4 12</p> <p>15 10 3 16</p> <p>11 2 8 13</p> <p>7</p>		

[ Type n2=1: ]

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	2			7		2			6		2			4
16					4	16				4	16			9
	5			9		7			10		7			12
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			10					8				3		
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		16					16					16		
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	2			6		2			4		3			4
15					4	15				8	14			8
	5			9		9			11		7			5
	14	3	10	7		10	7	12	5		9	2	10	13
			11					3					11	
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		14					14					14		
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	4			2		4			2		4			2
15					13	15				13	15			13
	6			11		7			10		10			7
	8	10	7	9		119	8	6			8	6	119	
			3				3						3	
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		16					16					13		
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	4			8		4			5		5			8
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	5			9		10			11		4			14
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			10					2					3	
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	5			6		5			2		6			10
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	11			7		8			4		5			13
	4	2	16	12		7	3	9	15		7	11	14	2
			8					11					3	
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		13					14					12		
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	6			9		6			8		7			3
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	4			15		9			3		4			13
	8	11	12	3		4	2	16	12		15	11	6	2
			5					10					5	
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	7			3		7			10		8			2
14					10	12				2	16			12
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			5					13					3	

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<p>83#</p> <p>7</p> <p>12 1 13 8</p> <p>11 4</p> <p>15 10 15</p> <p>2 16</p> <p>9 14 5 6</p> <p>3</p>	<p>84#</p> <p>7</p> <p>9 1 14 10</p> <p>11 5</p> <p>15 8 13</p> <p>12 6</p> <p>2 3 16 13</p> <p>4</p>	<p>85#</p> <p>9</p> <p>5 1 12 16</p> <p>11 7</p> <p>13 6</p> <p>4 3</p> <p>14 2 10 8</p> <p>15</p>
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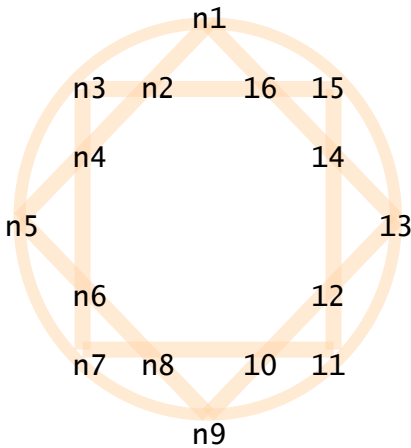
<p>92#</p> <p>4 1 8 14 15</p> <p>12 5</p> <p>13 7</p> <p>2 11</p> <p>16 9 6 3</p> <p>10</p>	<p>93#</p> <p>16 1 8 14 3</p> <p>12 5</p> <p>13 7</p> <p>2 11</p> <p>4 9 6 15</p> <p>10</p>	<p>94#</p> <p>2 1 11 16 15</p> <p>12 3</p> <p>10 4</p> <p>6 9</p> <p>14 5 8 7</p> <p>13</p>
<p>95#</p> <p>12 1 6 16 5</p> <p>13 3</p> <p>14 9</p> <p>2 11</p> <p>7 8 4 15</p> <p>10</p>	<p>96#</p> <p>7 1 8 16 10</p> <p>13 4</p> <p>12 6</p> <p>11 5</p> <p>3 2 14 15</p> <p>9</p>	<p>97#</p> <p>7 1 9 16 10</p> <p>13 4</p> <p>11 5</p> <p>12 6</p> <p>2 3 15 14</p> <p>8</p>
<p>98#</p> <p>3 1 11 16 14</p> <p>13 5</p> <p>9 2</p> <p>6 7</p> <p>12 4 10 8</p> <p>15</p>	<p>99#</p> <p>11 1 3 15 7</p> <p>14 6</p> <p>16 10</p> <p>4 13</p> <p>5 12 9 8</p> <p>2</p>	<p>100#</p> <p>7 1 4 16 10</p> <p>14 2</p> <p>15 12</p> <p>5 13</p> <p>8 11 6 9</p> <p>3</p>
<p>101#</p> <p>8 1 4 16 9</p> <p>14 2</p> <p>15 12</p> <p>5 13</p> <p>7 11 6 10</p> <p>3</p>	<p>102#</p> <p>2 1 6 16 15</p> <p>14 5</p> <p>13 7</p> <p>8 11</p> <p>10 9 12 3</p> <p>4</p>	<p>103#</p> <p>5 1 6 16 12</p> <p>14 3</p> <p>13 9</p> <p>8 4</p> <p>7 2 10 15</p> <p>11</p>
<p>104#</p> <p>7 1 6 15 11</p> <p>14 8</p> <p>13 5</p> <p>9 3</p> <p>4 2 16 12</p> <p>10</p>	<p>105#</p> <p>5 1 7 15 13</p> <p>14 8</p> <p>12 4</p> <p>9 3</p> <p>6 2 16 10</p> <p>11</p>	<p>106#</p> <p>5 1 7 15 13</p> <p>14 8</p> <p>12 4</p> <p>9 11</p> <p>6 10 16 2</p> <p>3</p>
<p>107#</p> <p>12 1 11 16 5</p> <p>14 4</p> <p>8 3</p> <p>6 15</p> <p>2 13 9 10</p> <p>7</p>	<p>108#</p> <p>5 1 11 16 12</p> <p>14 3</p> <p>8 4</p> <p>13 9</p> <p>2 7 15 10</p> <p>6</p>	<p>109#</p> <p>3 1 6 16 14</p> <p>15 2</p> <p>12 10</p> <p>7 5</p> <p>9 4 8 13</p> <p>11</p>
<p>110#</p> <p>3 1 11 16 14</p> <p>15 2</p> <p>7 5</p> <p>12 10</p> <p>4 9 13 8</p> <p>6</p>	<p>111#</p> <p>7 1 13 16 10</p> <p>15 3</p> <p>5 2</p> <p>4 12</p> <p>8 11 6 9</p> <p>14</p>	<p>112#</p> <p>8 1 13 16 9</p> <p>15 3</p> <p>5 2</p> <p>4 12</p> <p>7 11 6 10</p> <p>14</p>

[Count = 49 + 63 = 112]

But, I have not yet discovered how I should have them classified smart and what system of transformations I should take for that purpose.

Let's study the structure of our object here with some algebraic calculations.

**\* Algebra for Magic Star of Order 8 \***



**\* Basic Definition \***

$$\begin{aligned} n1+n2+n4+n5=C & \dots r1 \\ n3+n4+n6+n7=C & \dots r2 \\ n5+n6+n8+n9=C & \dots r3 \\ n7+n8+n10+n11=C & \dots r4 \\ n9+n10+n12+n13=C & \dots r5 \\ n11+n12+n14+n15=C & \dots r6 \\ n13+n14+n16+n1=C & \dots r7 \\ n15+n16+n2+n3=C & \dots r8 \end{aligned}$$

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$$2*(n1+n2+n3+\dots+n15+n16)=8*C$$

$$2*136=8*C$$

Therefore C=34 ... r1

**L2+L3+L5+L6+L8**

$$n3+n4+n6+n7+n5+n6+n8+n9+n9+n10+n12+n13+n11+n12+n14+n15+n15+n16+n2+n3=5*C$$

$$(n3+n6+n9+n12+n15)+(n2+n3+n4+n5+n6+n7+n8+n9+n10+n11+n12+n13+n14+n15+n16)=170$$

Add n1 to both sides.

$$(n3+n6+n9+n12+n15)+(n1+n2+n3+n4+n5+n6+\dots+n14+n15+n16)=170+n1$$

$$(n3+n6+n9+n12+n15)+ \quad 136 \quad =170+n1$$

Therefore n1=n3+n6+n9+n12+n15-34 ... r2

**L1+L3+L4+L6+L7**

$$n1+n2+n4+n5+n5+n6+n8+n9+n7+n8+n10+n11+n11+n12+n14+n15+n13+n14+n16+n1=5*C$$

$$(n1+n5+n8+n11+n14)+(n1+n2+n4+n5+n6+n7+n8+n9+n10+n11+n12+n13+n14+n15+n16)=170$$

Add n3 to both sides.

$$(n1+n5+n8+n11+n14)+(n1+n2+n3+n4+n5+n6+\dots+n14+n15+n16)=170+n3$$

Therefore n3=n1+n5+n8+n11+n14-34 ... r3

Similarly n5=n3+n7+n10+n13+n16-34 ... r4

n7=n2+n5+n9+n12+n15-34 ... r5

n9=n1+n4+n7+n11+n14-34 ... r6

n11=n3+n6+n9+n13+n16-34 ... r7

n13=n2+n5+n8+n11+n15-34 ... r8

n15=n1+n4+n7+n10+n13-34 ... r9

**T2+T3+T5+T6+T7**

$$n3+n4+n6+n7+n5+n6+n8+n9+n9+n10+n12+n13+n11+n12+n14+n15+n13+n14+n16+n1=5*C$$

$$(n6+n9+n12+n13+n14)+(n1+n3+n4+n5+n6+n7+n8+n9+n10+n11+n12+n13+n14+n15+n16)=170$$

Add n2 to both sides.

$$(n6+n9+n12+n13+n14)+(n1+n2+n3+n4+n5+\dots+n14+n15+n16)=170+n2$$

Therefore n2=n6+n9+n12+n13+n14-34 ... r10

**T3+T4+T6+T7+T8**

$$n5+n6+n8+n9+n7+n8+n10+n11+n11+n12+n14+n15+n13+n14+n16+n1+n15+n16+n2+n3=5*C$$

$$(n8+n11+n14+n15+n16)+(n1+n2+n3+n5+n6+n7+n8+n9+n10+n11+n12+n13+n14+n15+n16)=170$$

Add n4 to both sides.

$$(n8+n11+n14+n15+n16)+(n1+n2+n3+n4+n5+\dots+n14+n15+n16)=170+n4$$

Therefore n4=n8+n11+n14+n15+n16-34 ... r11

Similarly n6=n1+n2+n10+n13+n16-34 ... r12

n8=n2+n3+n4+n12+n15-34 ... r13

n10=n1+n4+n5+n6+n14-34 ... r14

$$\begin{aligned}n_{12} &= n_3 + n_6 + n_7 + n_8 + n_{16} - 34 && \dots r_{15} \\n_{14} &= n_2 + n_5 + n_8 + n_9 + n_{10} - 34 && \dots r_{16} \\n_{16} &= n_4 + n_7 + n_{10} + n_{11} + n_{12} - 34 && \dots r_{17}\end{aligned}$$

L1+L3+L5+L7

$$\begin{aligned}n_1 + n_2 + n_4 + n_5 + n_6 + n_8 + n_9 + n_{10} + n_{12} + n_{13} + n_{14} + n_{16} + n_1 &= 4 * C \\(n_1 + n_5 + n_9 + n_{13}) + (n_1 + n_2 + n_4 + n_5 + n_6 + n_8 + n_9 + n_{10} + n_{12} + n_{13} + n_{14} + n_{16}) &= 136\end{aligned}$$

Add (n3+n7+n11+n15) to both sides.

$$\begin{aligned}(n_1 + n_5 + n_9 + n_{13}) + (n_1 + n_2 + n_3 + n_4 + n_5 + n_6 + n_7 + \dots + n_{14} + n_{15} + n_{16}) &= 136 + n_3 + n_7 + n_{11} + n_{15} \\(n_1 + n_5 + n_9 + n_{13}) + 136 &= 136 + n_3 + n_7 + n_{11} + n_{15}\end{aligned}$$

Therefore  $n_1 + n_5 + n_9 + n_{13} = n_3 + n_7 + n_{11} + n_{15}$  ... r18

T1+T2+T4+T7

$$\begin{aligned}n_1 + n_2 + n_4 + n_5 + n_3 + n_4 + n_6 + n_7 + n_7 + n_8 + n_{10} + n_{11} + n_{13} + n_{14} + n_{16} + n_1 &= 4 * C \\(n_1 + n_4 + n_7) + (n_1 + n_2 + n_3 + n_4 + n_5 + n_6 + n_7 + n_8 + n_{10} + n_{11} + n_{13} + n_{14} + n_{16}) &= 136\end{aligned}$$

Add n9+n12+n15 to both sides.

$$\begin{aligned}(n_1 + n_4 + n_7) + (n_1 + n_2 + n_3 + n_4 + n_5 + n_6 + \dots + n_{14} + n_{15} + n_{16}) &= 136 + n_9 + n_{12} + n_{15} \\(n_1 + n_4 + n_7) + 136 &= 136 + n_9 + n_{12} + n_{15}\end{aligned}$$

Therefore  $n_1 + n_4 + n_7 = n_9 + n_{12} + n_{15}$  ... r19

T1+T3+T6+T8

$$\begin{aligned}n_1 + n_2 + n_4 + n_5 + n_5 + n_6 + n_8 + n_9 + n_{11} + n_{12} + n_{14} + n_{15} + n_{15} + n_{16} + n_2 + n_3 &= 4 * C \\(n_2 + n_5 + n_{15}) + (n_1 + n_2 + n_3 + n_4 + n_5 + n_6 + n_8 + n_9 + n_{11} + n_{12} + n_{14} + n_{15} + n_{16}) &= 136\end{aligned}$$

Add n7+n10+n13 to both sides.

$$(n_2 + n_5 + n_{15}) + (n_1 + n_2 + n_3 + n_4 + n_5 + n_6 + \dots + n_{14} + n_{15} + n_{16}) = 136 + n_7 + n_{10} + n_{13}$$

Therefore  $n_2 + n_5 + n_{15} = n_7 + n_{10} + n_{13}$  ... r20

T2+T3+T5+T8

$$\begin{aligned}n_3 + n_4 + n_6 + n_7 + n_5 + n_6 + n_8 + n_9 + n_9 + n_{10} + n_{12} + n_{13} + n_{15} + n_{16} + n_2 + n_3 &= 4 * C \\(n_3 + n_6 + n_9) + (n_2 + n_3 + n_4 + n_5 + n_6 + n_7 + n_8 + n_9 + n_{10} + n_{12} + n_{13} + n_{15} + n_{16}) &= 136\end{aligned}$$

Add n1+n11+n14 to both sides.

$$(n_3 + n_6 + n_9) + (n_1 + n_2 + n_3 + n_4 + n_5 + n_6 + \dots + n_{14} + n_{15} + n_{16}) = 136 + n_1 + n_{11} + n_{14}$$

Therefore  $n_3 + n_6 + n_9 = n_1 + n_{11} + n_{14}$  ... r21

T1+T3+T4+T6

$$\begin{aligned}n_1 + n_2 + n_4 + n_5 + n_5 + n_6 + n_8 + n_9 + n_7 + n_8 + n_{10} + n_{11} + n_{11} + n_{12} + n_{14} + n_{15} &= 4 * C \\(n_5 + n_8 + n_{11}) + (n_1 + n_2 + n_4 + n_5 + n_6 + n_7 + n_8 + n_9 + n_{10} + n_{11} + n_{12} + n_{14} + n_{15}) &= 136\end{aligned}$$

Add n3+n13+n16 to both sides.

$$(n_5 + n_8 + n_{11}) + (n_1 + n_2 + n_3 + n_4 + n_5 + n_6 + \dots + n_{14} + n_{15} + n_{16}) = 136 + n_3 + n_{13} + n_{16}$$

Therefore  $n_5 + n_8 + n_{11} = n_3 + n_{13} + n_{16}$  ... r22

T1+T2+T6+T7

$$\begin{aligned}n_1 + n_2 + n_4 + n_5 + n_3 + n_4 + n_6 + n_7 + n_{11} + n_{12} + n_{14} + n_{15} + n_{13} + n_{14} + n_{16} + n_1 &= 4 * C \\(n_1 + n_4 + n_{14}) + (n_1 + n_2 + n_3 + n_4 + n_5 + n_6 + n_7 + n_{11} + n_{12} + n_{13} + n_{14} + n_{15} + n_{16}) &= 136\end{aligned}$$

Add n8+n9+n10 to both sides.

$$(n_1 + n_4 + n_{14}) + (n_1 + n_2 + n_3 + n_4 + n_5 + n_6 + \dots + n_{14} + n_{15} + n_{16}) = 136 + n_8 + n_9 + n_{10}$$

Therefore  $n_1 + n_4 + n_{14} = n_8 + n_9 + n_{10}$  ... r23

T1+T3+T4+T8

$$\begin{aligned}n_1 + n_2 + n_4 + n_5 + n_5 + n_6 + n_8 + n_9 + n_7 + n_8 + n_{10} + n_{11} + n_{15} + n_{16} + n_2 + n_3 &= 4 * C \\(n_2 + n_5 + n_8) + (n_1 + n_2 + n_3 + n_4 + n_5 + n_6 + n_7 + n_8 + n_9 + n_{10} + n_{11} + n_{15} + n_{16}) &= 136\end{aligned}$$

Add n12+n13+n14 to both sides.

$$(n_2 + n_5 + n_8) + (n_1 + n_2 + n_3 + n_4 + n_5 + n_6 + \dots + n_{14} + n_{15} + n_{16}) = 136 + n_{12} + n_{13} + n_{14}$$

Therefore  $n_2 + n_5 + n_8 = n_{12} + n_{13} + n_{14}$  ... r24

Similarly  $n_6 + n_9 + n_{12} = n_1 + n_2 + n_{16}$  ... r25

$n_{10} + n_{13} + n_{16} = n_4 + n_5 + n_6$  ... r26

T2+T3+T7+T8

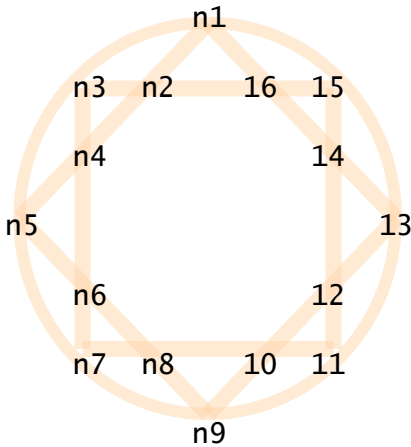
$$\begin{aligned}n_3 + n_4 + n_6 + n_7 + n_5 + n_6 + n_8 + n_9 + n_{13} + n_{14} + n_{16} + n_1 + n_{15} + n_{16} + n_2 + n_3 &= 4 * C \\(n_3 + n_6 + n_{16}) + (n_1 + n_2 + n_3 + n_4 + n_5 + n_6 + n_7 + n_8 + n_9 + n_{13} + n_{14} + n_{15} + n_{16}) &= 136\end{aligned}$$

Add n10+n11+n12 to both sides.

$$(n_3 + n_6 + n_{16}) + (n_1 + n_2 + n_3 + n_4 + n_5 + n_6 + \dots + n_{14} + n_{15} + n_{16}) = 136 + n_{10} + n_{11} + n_{12}$$

Therefore  $n_3 + n_6 + n_{16} = n_{10} + n_{11} + n_{12}$  ... r27

Similarly  $n_4+n_7+n_{10}=n_{14}+n_{15}+n_{16}$  ... r28  
 $n_8+n_{11}+n_{14}=n_2+n_3+n_4$  ... r29  
 $n_2+n_{12}+n_{15}=n_6+n_7+n_8$  ... r30



$n_1+n_2+n_4+n_5=C$  ... 11  
 $n_3+n_4+n_6+n_7=C$  ... 12  
 $n_5+n_6+n_8+n_9=C$  ... 13  
 $n_7+n_8+n_{10}+n_{11}=C$  ... 14  
 $n_9+n_{10}+n_{12}+n_{13}=C$  ... 15  
 $n_{11}+n_{12}+n_{14}+n_{15}=C$  ... 16  
 $n_{13}+n_{14}+n_{16}+n_1=C$  ... 17  
 $n_{15}+n_{16}+n_2+n_3=C$  ... 18

**\* Summary: List of Relations \***

$n_1=n_3+n_6+n_9+n_{12}+n_{15}-34$  ... r2;       $n_2=n_6+n_9+n_{12}+n_{13}+n_{14}-34$  ... r10  
 $n_3=n_1+n_5+n_8+n_{11}+n_{14}-34$  ... r3;       $n_4=n_8+n_{11}+n_{14}+n_{15}+n_{16}-34$  ... r11  
 $n_5=n_3+n_7+n_{10}+n_{13}+n_{16}-34$  ... r4;       $n_6=n_1+n_2+n_{10}+n_{13}+n_{16}-34$  ... r12  
 $n_7=n_2+n_5+n_9+n_{12}+n_{15}-34$  ... r5;       $n_8=n_2+n_3+n_4+n_{12}+n_{15}-34$  ... r13  
 $n_9=n_1+n_4+n_7+n_{11}+n_{14}-34$  ... r6;       $n_{10}=n_1+n_4+n_5+n_6+n_{14}-34$  ... r14  
 $n_{11}=n_3+n_6+n_9+n_{13}+n_{16}-34$  ... r7;       $n_{12}=n_3+n_6+n_7+n_8+n_{16}-34$  ... r15  
 $n_{13}=n_2+n_5+n_8+n_{11}+n_{15}-34$  ... r8;       $n_{14}=n_2+n_5+n_8+n_9+n_{10}-34$  ... r16  
 $n_{15}=n_1+n_4+n_7+n_{10}+n_{13}-34$  ... r9;       $n_{16}=n_4+n_7+n_{10}+n_{11}+n_{12}-34$  ... r17

$n_1+n_5+n_9+n_{13}=n_3+n_7+n_{11}+n_{15}$  ... r18

$n_1+n_4+n_7=n_9+n_{12}+n_{15}$  ... r19;       $n_6+n_9+n_{12}=n_1+n_2+n_{16}$  ... r25  
 $n_2+n_5+n_{15}=n_7+n_{10}+n_{13}$  ... r20;       $n_{10}+n_{13}+n_{16}=n_4+n_5+n_6$  ... r26  
 $n_3+n_6+n_9=n_1+n_{11}+n_{14}$  ... r21;       $n_3+n_6+n_{16}=n_{10}+n_{11}+n_{12}$  ... r27  
 $n_5+n_8+n_{11}=n_3+n_{13}+n_{16}$  ... r22;       $n_4+n_7+n_{10}=n_{14}+n_{15}+n_{16}$  ... r28  
 $n_1+n_4+n_{14}=n_8+n_9+n_{10}$  ... r23;       $n_8+n_{11}+n_{14}=n_2+n_3+n_4$  ... r29  
 $n_2+n_5+n_8=n_{12}+n_{13}+n_{14}$  ... r24;       $n_2+n_{12}+n_{15}=n_6+n_7+n_8$  ... r30

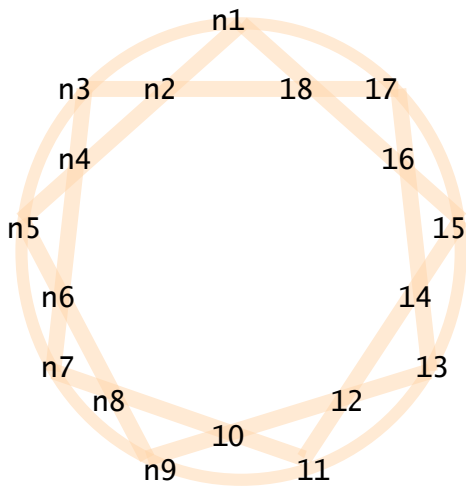
Those relational equations above seem to imply various types of transformations may possibly be discovered. However, the solution counts of the two types are different from each other: 49 for the type whose  $n_1=1$  and 63 for the one whose  $n_2=1$ . That means you might have no such smart system of transformations and classifying methods on the whole, I am afraid.

About higher orders than 8, let me report of my newest result only with the data-sheets as follows. Otherwise, it might be too long and boring for you to follow.

(Original in Japanese: Written first on Aug.22, 2000;  
 English Version: Written on Nov.23, 2005;  
 By Kanji Setsuda working on MacOSX and Xcode 1.5)

# Chapter 6: Algebraic Study of Magic Stars of Higher Orders

## Section 1: Data for Double-Ringed Magic Stars of Order 9



\* Basic Definition for **Order 9** \*

$$\begin{aligned} n1+n2+n4+n5=C & \dots r1 \\ n3+n4+n6+n7=C & \dots r2 \\ n5+n6+n8+n9=C & \dots r3 \\ n7+n8+n10+n11=C & \dots r4 \\ n9+n10+n12+n13=C & \dots r5 \\ n11+n12+n14+n15=C & \dots r6 \\ n13+n14+n16+n17=C & \dots r7 \\ n15+n16+n18+n1=C & \dots r8 \\ n17+n18+n2+n3=C & \dots r9 \end{aligned}$$

$$\begin{aligned} 2*(n1+n2+n3+\dots+n17+n18) &= 9*C \\ 2*171 &= 9*C \end{aligned}$$

Therefore  $C=38 \dots r0$

### Algebraic Calculations:

$$r1+r3+r5+r7+r9$$

$$n1+n2+n2+n3+n4+n5+n5+n6+n8+n9+n9+n10+n12+n13+n13+n14+n16+n17+n17+n18=5C$$

$$+n7+n11+n15=n7+n11+n15$$

$$\begin{aligned} (n1+n2+n3+n4+n5+\dots+n16+n17+n18) &+ n2+n5+n9+n13+n17=5C+n7+n11+n15 \\ 171 & \qquad \qquad \qquad +n2+n5+n9+n13+n17=190+n7+n11+n15 \end{aligned}$$

Therefore

$$n2=19-n5+n7-n9+n11-n13+n15-n17 \dots r1$$

In the same way you can get:

$$r2+r4+r6+r8+r10$$

$$n4=19-n7+n9-n11+n13-n15+n17-n1 \dots r2$$

$$r3+r5+r7+r9+r11$$

$$n6=19-n9+n11-n13+n15-n17+n1-n3 \dots r3$$

$$n8=19-n11+n13-n15+n17-n1+n3-n5 \dots r4$$

$$n10=19-n13+n15-n17+n1-n3+n5-n7 \dots r5$$

$$n12=19-n15+n17-n1+n3-n5+n7-n9 \dots r6$$

$$n14=19-n17+n1-n3+n5-n7+n9-n11 \dots r7$$

$$n16=19-n1+n3-n5+n7-n9+n11-n13 \dots r8$$

$$n18=19-n3+n5-n7+n9-n11+n13-n15 \dots r9$$

$$r1+r4+r5+r8+r9$$

$$n1+n2+n4+n5=C \dots r1$$

$$n7+n8+n10+n11=C \dots r4$$

$$n9+n10+n12+n13=C \dots r5$$

$$n15+n16+n18+n1=C \dots r8$$

$$+n17+n18+n2+n3=C \dots r9$$

$$n1+n1+n2+n2+n3+n4+n5+n7+n8+n9+n10+n10+n11+n12+n13+n15+n16+n18+n17+n18=5*C$$

$$(n1+n2+n10+n18)+(n1+n2+n3+n4+n5+n7+n8+n9+n10+n11+n12+n13+n15+n16+n17+n18)=190$$

Add (n6+n14) to both sides

$$(n1+n2+n10+n18)+(n1+n2+n3+n4+n5+n6+\dots+n14+n15+n16+n17+n18)=190+n6+n14$$

Therefore  $n1=19-n2+n6-n10+n14-n18 \dots r10$

$$r1+r2+r5+r6+r9$$

$$n1+n2+n4+n5+n3+n4+n6+n7+n9+n10+n12+n13+n11+n12+n14+n15+n17+n18+n2+n3=5*C$$

$$(n2+n3+n4+n12)+(n1+n2+n3+n4+n5+n6+n7+n9+n10+n11+n12+n13+n14+n15+n17+n18)=190$$

Add (n8+n16) to both sides

$$(n2+n3+n4+n12)+(n1+n2+n3+n4+n5+n6+n7+n8+\dots+n16+n17+n18)=190+n8+n16$$

Therefore  $n_3=19-n_2-n_4+n_8-n_{12}+n_{16} \dots r_{11}$

$11+12+13+16+17$

$n_1+n_2+n_4+n_5+n_3+n_4+n_6+n_7+n_5+n_6+n_8+n_9+n_{11}+n_{12}+n_{14}+n_{15}+n_{13}+n_{14}+n_{16}+n_{17}=5 \cdot C$

$(n_4+n_5+n_6+n_{14})+(n_1+n_2+n_3+n_4+n_5+n_6+n_7+n_8+n_9+n_{11}+n_{12}+n_{13}+n_{14}+n_{15}+n_{16}+n_{17})=190$

Add  $(n_{10}+n_{18})$  to both sides

$(n_4+n_5+n_6+n_{14})+(n_1+n_2+n_3+n_4+n_5+n_6+n_7+n_8+n_9+n_{10}+\dots+n_{16}+n_{17}+n_{18})=190+n_{10}+n_{18}$

Therefore  $n_5=19-n_4-n_6+n_{10}-n_{14}+n_{18} \dots r_{12}$

Similarly

$n_7=19+n_2-n_6-n_8+n_{12}-n_{16} \dots r_{13}$

$n_9=19+n_4-n_8-n_{10}+n_{14}-n_{18} \dots r_{14}$

$n_{11}=19-n_2+n_6-n_{10}-n_{12}+n_{16} \dots r_{15}$

$n_{13}=19-n_4+n_8-n_{12}-n_{14}+n_{18} \dots r_{16}$

$n_{15}=19+n_2-n_6+n_{10}-n_{14}-n_{16} \dots r_{17}$

$n_{17}=19+n_4-n_8+n_{12}-n_{16}-n_{18} \dots r_{18}$

**\*\* Making Magic Stars of Order 9 \*\***

**\*\* List of Standard Solutions: \*\***

[ Type  $n_1=1$ : ]

<p><b>1#</b></p> <pre> 1 3 17 14 4 18      10 2 12      8 13 5      16 15      6 9 7 11 </pre> <p><b>39#</b></p> <pre> 1 2 14 13 9 18      8 5      16 12      4 6      17 10      3 11 7 15 </pre> <p><b>154#</b></p> <pre> 1 2 11 16 9 18      14 8      7 12      10 6      5 15      17 3 13 4 </pre> <p><b>370#</b></p> <pre> 1 3 8 17 10 18      14 11      6 13      9 4      5 12      16 2 15 7 </pre>	<p><b>6#</b></p> <pre> 1 2 16 12 8 18      14 3 13      6 11 5      10 7      4 15 9 17 </pre> <p><b>63#</b></p> <pre> 1 2 13 9 14 18      11 6      17 15      5 3      8 7      4 10 16 12 </pre> <p><b>211#</b></p> <pre> 1 2 10 15 11 18      16 9      6 13      8 5      3 12      17 4 14 7 </pre> <p><b>426#</b></p> <pre> 1 3 7 11 17 18      10 11      16 13      2 4      9 5      6 8 15 14 </pre>	<p><b>16#</b></p> <pre> 1 2 15 9 12 18      17 4 13      3 11 5      6 7      8 14 10 16 </pre> <p><b>108#</b></p> <pre> 1 2 12 14 10 18      6 7      17 15      9 3      13 11      4 5 16 8 </pre> <p><b>296#</b></p> <pre> 1 2 9 11 16 18      12 10      14 15      4 3      6 5      7 8 17 13 </pre> <p><b>540#</b></p> <pre> 1 2 6 14 16 18      15 13      8 11      3 7      4 9      17 5 12 10 </pre>
---	---	---

659#

```

      2 5 1 16 15
      18      8
14     11 9 13
      7     6
        10 12
          3 17 4

```

1176#

```

      5 2 1 15 16
      18      12
17     9 3 10
      6     7
        8 14
          4 13 11

```

[ Type n2=1: ]

1513#

```

      16 1 17 8 13
      2     10
18     5 9 3
      15     6
        4 14
          11 7 12

```

1627#

```

      12 1 14 16 9
      5     6 2
18     4 15 8
      17     8
        3 10
          13 7 11

```

1838#

```

      16 1 11 15 6
      8     9 3
18     2 13 3
      12     10
        14 17
          4 7 5

```

2118#

```

      15 1 8 6 16
      11     7
18     2 17
      10     3 12
        14 13
          4 9 5

```

793#

```

      3 4 1 17 14
      18      12
15     11 5 8
      6     7
        10 16
          2 13 9

```

1439#

```

      14 2 1 16 6
      17      9
18     3 8 12
      4     15
        10 5
          7 11 13

```

1541#

```

      17 1 16 9 11
      3     5
18     4 15 8
      14     7
        10 13
          6 12 2

```

1693#

```

      14 1 13 16 7
      6     4
18     3 10 5
      15     17
        9 11
          8 2 12

```

1923#

```

      14 1 10 16 7
      9     8 4
18     2 11 4
      13     12
        3 6
          15 5 17

```

2204#

```

      10 1 7 16 11
      12     6 9
18     2 8
      14     13
        15 17
          3 5 4

```

958#

```

      4 3 1 14 17
      18      8
16     10 2 15
      6     11
        7 9
          5 13 12

```

1582#

```

      14 1 15 12 11
      4     6
18     3 8 5
      17     13
        10 16
          7 2 9

```

1773#

```

      17 1 12 15 5
      7     9
18     3 14 2
      11     10
        13 16
          4 8 6

```

2029#

```

      14 1 9 8 15
      10     16
18     2 3 5
      12     4
        7 17
          11 6 13

```

2319#

```

      14 1 6 16 7
      13     11
18     2 12 5
      9     8
        15 17
          3 10 4

```

2423#                      2549#                      2670#

```

      5
    9 1 17 11
   14      12
  18      4 18      3
  2      8 2      6
 13      7 12      7
      3 10      8 16      13 17
      6 16      10 13      5 7 6
    15
  
```

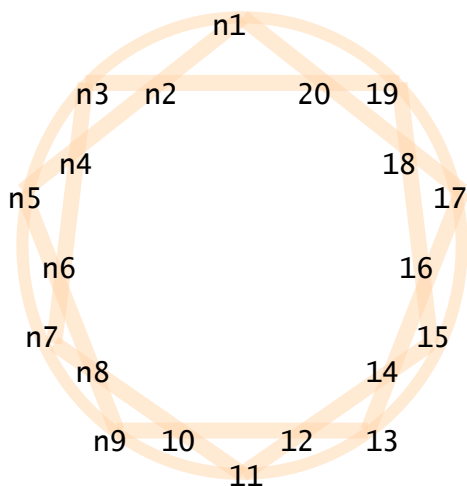
2817#                      2959#

```

      2
    6 1 16 15
   17      11
  18      9 17      7
  3      5 4      5
 12      7 6      3
      4 10      9 15
      8 14      12 11
    13
  
```

[Count = 1512 + 1502 = 3014] OK!

## Section 2: Data for Double-Ringed Magic Stars of Order 10



\* Basic Definition for **Order 10** \*

$n_1+n_2+n_4+n_5=C$             ... 11  
 $n_3+n_4+n_6+n_7=C$             ... 12  
 $n_5+n_6+n_8+n_9=C$             ... 13  
 $n_7+n_8+n_{10}+n_{11}=C$         ... 14  
 $n_9+n_{10}+n_{12}+n_{13}=C$         ... 15  
 $n_{11}+n_{12}+n_{14}+n_{15}=C$         ... 16  
 $n_{13}+n_{14}+n_{16}+n_{17}=C$         ... 17  
 $n_{15}+n_{16}+n_{18}+n_{19}=C$         ... 18  
 $n_{17}+n_{18}+n_{20}+n_1=C$         ... 19  
 $n_{19}+n_{20}+n_2+n_3=C$         ... 110

---

$2*(n_1+n_2+n_3+\dots+n_{19}+n_{20})=10*C$   
 $2*210=10*C$   
 Therefore  $C=42$     ... r0

11+13+15+17+19

$$n_1+n_2+n_4+n_5+n_6+n_8+n_9+n_{10}+n_{12}+n_{13}+n_{14}+n_{16}+n_{17}+n_{18}+n_{20}+n_1=5*C$$

$$(n_1+n_5+n_9+n_{13}+n_{17})+(n_1+n_2+n_4+n_5+n_6+n_8+n_9+n_{10}+n_{12}+n_{13}+n_{14}+n_{16}+n_{17}+n_{18}+n_{20})=210$$

Add (n3+n7+n11+n15+n19) to both sides.

$$(n_1+n_5+n_9+n_{13}+n_{17})+(n_1+n_2+n_3+n_4+\dots+n_{18}+n_{19}+n_{20})=210+n_3+n_7+n_{11}+n_{15}+n_{19}$$

Therefore  $n_1+n_5+n_9+n_{13}+n_{17}=n_3+n_7+n_{11}+n_{15}+n_{19}$     ... r1

11+12+14+16+18+110

$$n_1+n_2+n_4+n_5+n_6+n_7+n_8+n_{10}+n_{11}+n_{12}+n_{14}+n_{15}+n_{16}+n_{18}+n_{19}+n_{19}+n_{20}+n_2+n_3=252$$

$$(n_2+n_3+n_4+n_7+n_{11}+n_{15}+n_{19})+(n_1+n_2+n_3+n_4+\dots+n_{18}+n_{19}+n_{20})=252$$

Add (n9+n13+n17) to both sides.

$$(n_2+n_3+n_4+n_7+n_{11}+n_{15}+n_{19})+(n_1+n_2+n_3+n_4+\dots+n_{18}+n_{19}+n_{20})=252+n_9+n_{13}+n_{17}$$

Therefore  $n_2+n_3+n_4+n_7+n_{11}+n_{15}+n_{19}=42+n_9+n_{13}+n_{17}$     ... r2

.....

\*\* Composing Standard Magic Stars of Order 10 \*\*  
 \*\* List of Solutions of Type n1=1 & n2=1(Part): \*\*

1#					42#				
		1					1		
	3	19	7	13		2	18	9	13
	20			18		20			15
2				16	3				17
15				5	16				6
4				6	4				8
	17			12		12			5
	8	11	14	9		11	7	10	14
		10					19		
84#					198#				
		1					1		
	2	17	9	14		2	16	14	10
	20			19		20			19
4				13	5				8
15				3	17				4
5				6	3				9
	12			10		13			12
	11	7	8	16		7	11	6	18
		18					15		
307#					440#				
		1					1		
	2	15	14	11		2	14	10	16
	20			19		20			13
6				8	7				18
17				5	15				4
3				7	5				9
	9			13		12			3
	10	12	4	16		8	6	11	17
		18					19		
611#					814#				
		1					1		
	2	13	10	17		2	12	15	13
	20			15		20			7
8				16	9				19
6				3	16				5
14				7	4				17
	19			12		14			8
	9	4	18	11		3	18	11	10
		5					6		
1031#					1279#				
		1					1		
	2	11	17	12		2	10	16	14
	20			19		20			7
10				5	11				18
16				8	17				8
4				3	3				13
	7			15		5			4
	9	13	6	14		9	15	6	12
		18					19		

1468#

2 9 1  
 20  
 12  
 13  
 7  
 6  
 11 10  
 19

1953#

2 7 1  
 20  
 14  
 12  
 8  
 10  
 6 11  
 13

2600#

2 5 1  
 20  
 16  
 12  
 8  
 11  
 3 19  
 4

3464#

4 3 1  
 20  
 18  
 12  
 6  
 10  
 2 17  
 9

4694#

5 2 1  
 19  
 20  
 12  
 6  
 7  
 3 15  
 14

1660#

2 8 1  
 20  
 8 13  
 3 17  
 5 3  
 5  
 7 19  
 15

2298#

3 6 1  
 20  
 4 15  
 5 12  
 3 7  
 10  
 5 9  
 16

3021#

3 4 1  
 20  
 17  
 11  
 8  
 9  
 5 18  
 7

4073#

5 2 1  
 20  
 19  
 13  
 4  
 7  
 3 16  
 15

5304#

19 1 18  
3  
20 4  
16 11  
7 13  
2

5393#

17 1 16  
5  
20 2  
18 7  
13 6  
11

5619#

16 1 14  
7  
20 2  
17 12  
8 10  
3

5948#

13 1 12  
9  
20 2  
18 4  
16 15  
5

6440#

14 1 10  
11  
20 2  
15 3  
17 5  
19

5318#

19 1 17  
4  
20 3  
16 11  
8 10  
5

5472#

16 1 15  
6  
20 2  
18 3  
17 13  
8

5767#

14 1 13  
8  
20 2  
18 4  
16 11  
9

6129#

13 1 11  
10  
20 2  
17 14  
6 3  
8

6671#

10 1 9  
12  
20 2  
18 7  
13 6  
11

9 13  
2  
14  
15  
12  
7  
6

14 11  
9  
4  
12  
10  
19  
7

17 10  
7  
5  
19  
6  
15  
3

19 9  
5  
7  
16  
12  
4  
15

14 17  
16  
3  
5  
4  
19  
15

6940#

7241#

		8					7		
9	1		17	15		9	1	19	13
13				12		14			6
20				5	20				10
2				11	2				12
18				4	17				11
14				16	4				5
6	7		19	10	16	3		8	15
		3					18		

7578#

7912#

		6					5		
8	1		19	14		7	1	19	15
15				5		16			10
20				12	20				8
2				16	2				3
17				7	17				14
9				4	9				18
11	3		18	10	11	12		6	13
		13					4		

8442#

8893#

		4					3		
9	1		19	13		9	1	15	17
17				12		18			5
20				7	20				19
2				11	2				8
14				6	13				12
15				8	6				4
5	3		18	16	14	7		10	11
		10					16		

9493#

10157#

		2					2		
6	1		18	17		6	1	17	18
19				9		20			9
20				13	19				14
3				12	3				11
14				4	13				4
8				7	5				10
11	5		16	10	15	8		12	7
		15					16		

[Count = 5303 + 5579 = 10882] OK!

### Section 3: Data for Double-Ringed Magic Stars of Order 11

11+13+15+17+19+111

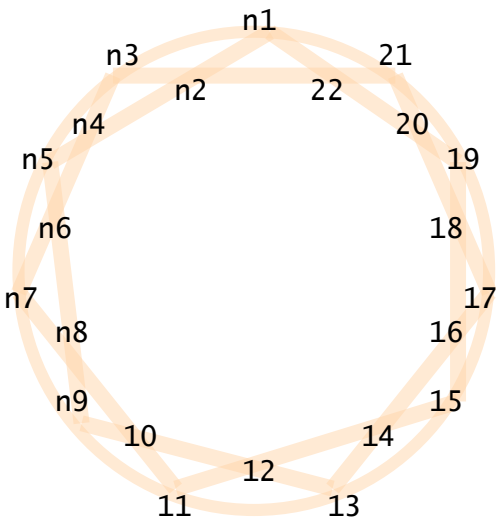
$$n1+n2+n4+n5+n5+n6+n8+n9+n9+n10+n12+n13+n13+n14+n16+n17+n17+n18+n20+n21+n21+n22+n2+n3=6*C$$

$$(n2+n5+n9+n13+n17+n21)+(n1+n2+n3+n4+n5+n6+n8+n9+n10+n12+n13+n14+n16+n17+n18+n20+n21+n22)=276$$

Add (n7+n11+n15+n19) to both sides.

$$(n2+n5+n9+n13+n17+n21)+(n1+n2+n3+n4+...+n20+n21+n22)=276+n7+n11+n15+n19$$

Therefore  $n_2+n_5+n_9+n_{13}+n_{17}+n_{21}=23+n_7+n_{11}+n_{15}+n_{19} \dots r_1$



\* Basic Definition \*

- $n_1+n_2+n_4+n_5=C \dots r_1$
- $n_3+n_4+n_6+n_7=C \dots r_2$
- $n_5+n_6+n_8+n_9=C \dots r_3$
- $n_7+n_8+n_{10}+n_{11}=C \dots r_4$
- $n_9+n_{10}+n_{12}+n_{13}=C \dots r_5$
- $n_{11}+n_{12}+n_{14}+n_{15}=C \dots r_6$
- $n_{13}+n_{14}+n_{16}+n_{17}=C \dots r_7$
- $n_{15}+n_{16}+n_{18}+n_{19}=C \dots r_8$
- $n_{17}+n_{18}+n_{20}+n_{21}=C \dots r_9$
- $n_{19}+n_{20}+n_{22}+n_1=C \dots r_{10}$
- $n_{21}+n_{22}+n_2+n_3=C \dots r_{11}$

-----  
 $2*(n_1+n_2+n_3+\dots+n_{21}+n_{22})=11*C$   
 $2*253=11*C$

Therefore  $C=46 \dots r_0$

**\*\* List of Standard Magic Stars of Order 11 \*\***

[Type n1=1]

<p>1#</p> <pre>       3  21  1  14  8     22      18   2 17 4 20 7   16     6  11  10 561#       2  19  1  15  10     22      16   4 17 5 18 7   20     3  13  6 1563#       2  17  1  16  11     22      21   6 15 7 12 13     9   18     5  19       3 </pre>	<p>294#</p> <pre>       2  20  1  15  9     22      12   13   5  16   15  6   9  19   19  8     11     10  14  5 1061#       2  18  1  15  11     22      17   14   5  19   8  3   11  16   9  6     20     7  8  12 2471#       2  16  1  15  13     22      20   8  7   4  19   10  3   14  14   20  6     17     5  18       12 </pre>	<pre>       1  15  9     12   18   4   21   7   17     5   17     21     5   13   10     21     8  12     21     7  8  12     21     1  15  13     17     10     4     9     11     21     8     5  18     12 </pre>
---	---	--

3243#

2 15 1 20 9  
 22 11 14 9 12  
 8 19 10 19 5  
 3 13 16 3 18  
 6 5 11 7 8  
 12 17 7 17 21  
 18 21 15 6 4

4340#

2 14 1 20 10  
 22 11 13 12 5  
 9 19 12 18  
 3 16 3 11 8  
 7 7 17 4 21  
 17 15 6 16  
 15 18 14 6  
 21 21 7 4

5378#

2 13 1 20 11  
 22 21 4 11 6  
 10 19 8 13 9  
 3 12 6 9 19 4  
 5 18 16 3 17 16  
 17 7 8 15 5  
 14 9 10 20

6649#

2 12 1 18 14  
 22 21 11 13 21 6  
 4 8 11 13 7  
 6 9 9 19 4  
 18 16 3 17 16  
 7 8 15 5  
 15 10 20  
 15 18 16 6  
 21 21 5 4

7797#

2 11 1 15 18  
 22 9 21 13 6  
 12 16 14 5 8 4  
 6 8 4 7 12 20  
 10 13 17 7 7 15  
 19 3 20 9 11 3  
 19 20 17 11 19

8980#

2 10 1 18 16  
 22 10 22 18 21  
 13 13 14 6  
 14 14 5 5  
 8 12 8 20  
 7 7 7 15  
 9 9 11 3  
 17 11 19

9958#

2 9 1 19 16  
 22 6 20 15 20  
 14 12 11 18 7  
 10 17 13 4 10 16  
 3 7 8 3 5 14  
 4 5 21 12  
 15 18 21 9 12  
 18 21 11 13

11347#

2 8 1 19 17  
 22 6 22 17 6  
 15 15 20 20  
 11 18 11 7  
 4 10 4 16  
 3 3 8 5  
 21 12  
 17 19 17 6  
 8 1 19 17  
 17 11 13

12687#

2 7 1 19 18  
 22 15 11 17 9  
 16 13 10 14 16  
 9 12 3 8 15  
 5 17 17 12 10  
 21 8 3 3 5  
 14 20 19 21  
 4 6 7 13 11

14328#

2 6 1 20 18  
 22 9 11 17 16  
 17 14 15 15 4  
 8 12 8 10 4  
 3 3 19 21 5  
 19 13 21  
 7 11

16001#

2 5 1 20 19  
 22 16  
 18 9 19  
 14 7 15  
 8 4 6  
 11 17 10  
 3 13 2  
 21 15 17  
 6 12 10  
 10

17983#

3 4 1 21 18  
 22 8  
 9 19 16  
 7 15 11  
 4 6 9  
 17 10 5  
 13 2 14  
 17 12  
 7 20  
 13

19805#

4 3 1 21 18  
 22 7  
 20 17 21  
 14 5 13  
 6 16 6  
 10 9 8  
 2 15 4  
 19 8 18  
 11 12 9 11  
 12 13 14 15

22288#

5 2 1 19 20  
 22 16  
 17 21 10  
 5 13 7  
 16 6 3  
 9 8 17  
 15 4 12  
 8 18 11  
 9 15

24491#

5 2 1 19 20  
 21 16  
 22 10  
 13 6  
 7 4  
 8 18  
 3 12  
 17 9  
 14 11 15

[Type n2=1]

27224#

21 1 20 5 19  
 3 10  
 22 11 22  
 4 2 3  
 18 15 18  
 6 16 5  
 14 17 16  
 13 8 8  
 9 12 7 12 10  
 18

27253#

21 1 19 11 13  
 4 7  
 11 22 9  
 2 3 6  
 15 18 20  
 16 5 14  
 17 16 17  
 8 8 2  
 15 12 10  
 17

27544#

19 1 18 10 16  
 5 3  
 22 15 22  
 2 6 2  
 20 21 20  
 8 12 3  
 14 13 19  
 11 9 8  
 7 17 4 9 8  
 15 10 9 5

27828#

18 1 17 13 14  
 6 4  
 15 22 12  
 6 2 7  
 21 20 21  
 12 3 11  
 13 19 16  
 9 8 5  
 15 10 9

28423#

17 1 16 10 18  
 7 11  
 22 9 22  
 2 12 2  
 20 5 20  
 3 21 9  
 19 4 13  
 8 14 7  
 15 13 6 10 12 14 5

28949#

16 1 15 11 18  
 8 3  
 9 22 17  
 12 2 4  
 5 20 21  
 21 9 6  
 4 13 19  
 7 5  
 10 12 14

29845#

15 1 14 13 17  
 9 3  
 22 16 22  
 2 5 2  
 20 21 20  
 4 6 7  
 18 19 15  
 10 8 16  
 12 7 11 3 4 11 21

30615#

14 1 13 19 12  
 10 8  
 14 22 6  
 10 2 17  
 21 20 9  
 6 7 5  
 19 15 18  
 16 21  
 3 4 11

31822#

14 1 12 21 10  
 11 8  
 22 5 22  
 2 15 2  
 19 13 18  
 6 9 3  
 16 17 19  
 3 4 8  
 18 7 20 17 13 6 9

32765#

14 1 11 10 21  
 12 5  
 22 22 20  
 2 2 4  
 18 3 16  
 9 3 15  
 17 19 7  
 8 9  
 17 13 6

34030#

11 1 10 18 16  
 13 6  
 22 12 22  
 2 9 2  
 20 15 20  
 5 4 5  
 17 21 17  
 7 8 18  
 14 3 19 3 7 4 21

35053#

10 1 9 19 16  
 14 6  
 12 22 12  
 9 2 11  
 15 20 13  
 4 5 8  
 21 17 15  
 18 21  
 3 7 4

36553#

9 1 8 17 19  
 15 11  
 22 10 22  
 2 3 2  
 20 13 20  
 4 12 17  
 18 21 5  
 16 14 6  
 6 5 7 3 21 14

38131#

8 1 7 18 19  
 16 11  
 10 22 10  
 3 2 12  
 13 20 4  
 12 17 15  
 21 5 9  
 6 13  
 3 21 14

39959#

8 1 6 21 16  
 17 5  
 22 14 22 20  
 2 12 2 8  
 19 13 19 13  
 4 11 10 3  
 18 9 12 15  
 3 7 11 16  
 20 10 6 9 14

41662#

7 1 5 17 21  
 18 4  
 14 22 20  
 12 2 8  
 13 19 13  
 11 10 3  
 9 12 15  
 11 16  
 6 9 14

43781#

7 1 4 17 21  
 19 16  
 22 9 22 13  
 2 6 2 10  
 18 3 16 5  
 10 20 7 9  
 12 11 15 14  
 5 8 6 11  
 13 14 15 17 4 21

45726#

8 1 3 18 19  
 20 12  
 22 22 13  
 6 2 10  
 3 16 5  
 20 7 9  
 11 15 14  
 6 11  
 17 4 21

48205#

6 1 2 19 20  
 21 11  
 22 14 21 16  
 3 10 3 5  
 16 5 15 14  
 8 15 4 12  
 13 7 18 13  
 4 9 10 9  
 18 12 17 7 11

50434#

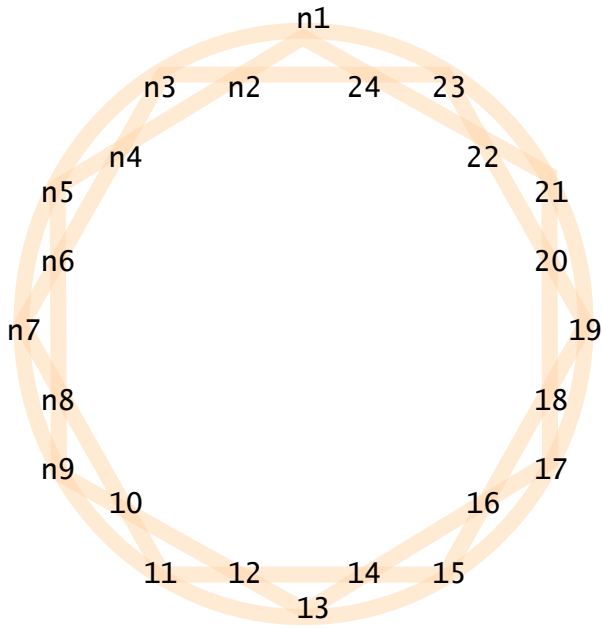
6 1 2 20 19  
 22 8  
 14 21 16  
 10 3 5  
 5 15 14  
 15 4 12  
 7 18 13  
 10 10 9  
 17 7 11

[Count = 27223 + 26305 = 53528] OK!

(English Version: Written on Nov. 25, 2005 by Kanji Setsuda)

\*\*\* E-Mail Address:<jag12001@nifty.com>

## Section 4: Data for Magic Stars of Order 12



### Basic Definition for Order 12

- $n1+n2+n4+n5=C \quad \dots \quad \uparrow 11$
- $n3+n4+n6+n7=C \quad \dots \quad \uparrow 12$
- $n5+n6+n8+n9=C \quad \dots \quad \uparrow 13$
- $n7+n8+n10+n11=C \quad \dots \quad \uparrow 14$
- $n9+n10+n12+n13=C \quad \dots \quad \uparrow 15$
- $n11+n12+n14+n15=C \quad \dots \quad \uparrow 16$
- $n13+n14+n16+n17=C \quad \dots \quad \uparrow 17$
- $n15+n16+n18+n19=C \quad \dots \quad \uparrow 18$
- $n17+n18+n20+n21=C \quad \dots \quad \uparrow 19$
- $n19+n20+n22+n23=C \quad \dots \quad \uparrow 10$
- $n21+n22+n24+n1=C \quad \dots \quad \uparrow 11$
- $n23+n24+n2+n3=C \quad \dots \quad \uparrow 12$

---

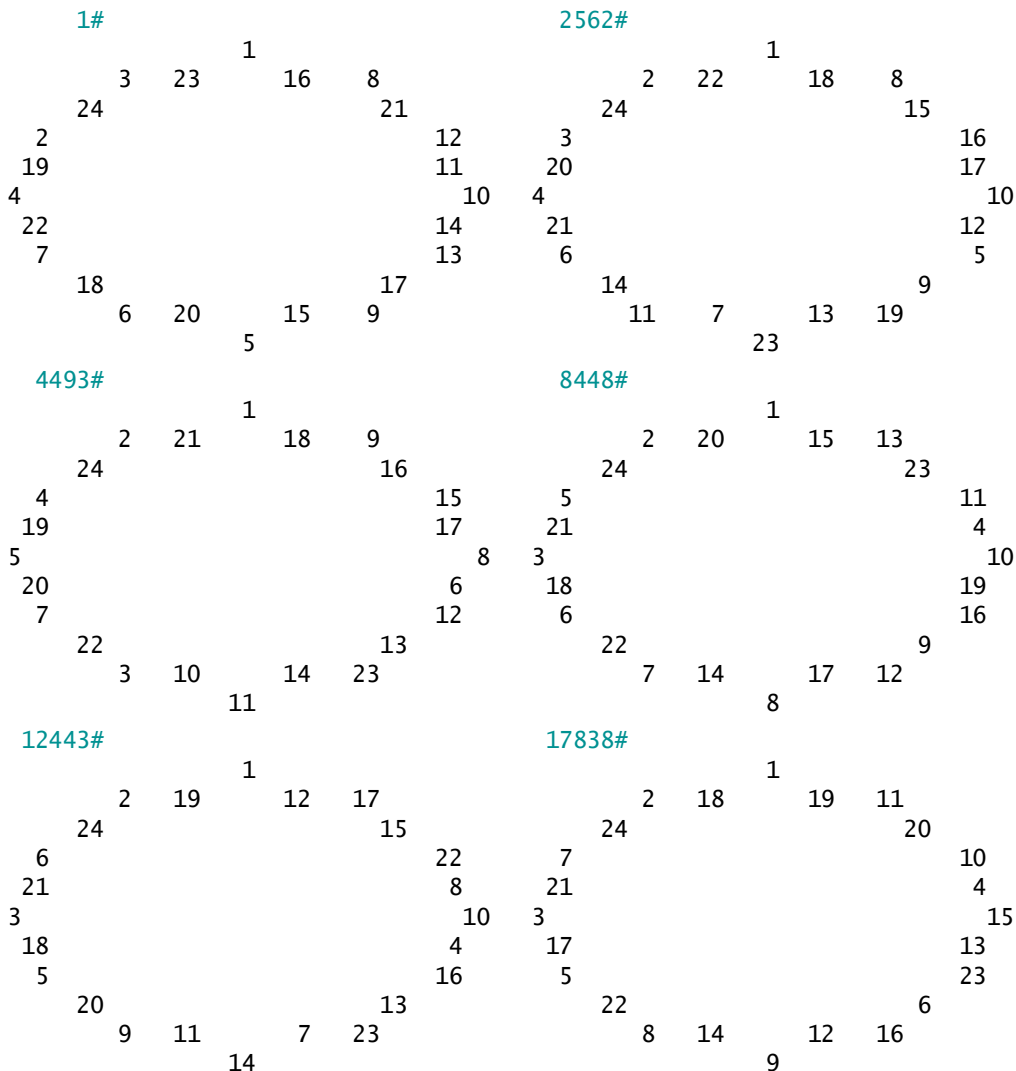

$$2*(n1+n2+n3+\dots+n23+n24)=12*C$$

$$2*300=12*C$$

Therefore  $C=50 \quad \dots \quad r0$

### \*\* List of Standard Magic Stars of Order 12 \*\*

[Type n1=1]



23060#

1  
 2 17 20 11  
 24 15  
 8 14 9 23  
 21 6 21 12  
 3 18 3 18  
 16 7 15 4  
 5 23 5 11  
 22 13  
 9 19 10 12 8  
 4 17 14 20

29959#

1  
 2 16 19 13  
 24 7  
 9 23  
 21 12  
 3 18 3 18  
 15 4  
 5 11  
 22 8  
 10 6 14 20  
 17

37046#

1  
 2 15 20 13  
 24 6  
 10 23 11 20  
 21 12 21 18  
 3 19 3 7  
 14 4 13 4  
 5 11 5 8  
 16 9 22 16  
 17 7 8 18 12 6 9 23  
 22 17

45013#

1  
 2 14 19 15  
 24 10  
 11 20  
 21 18  
 3 7  
 13 4  
 5 8  
 22 16  
 12 6 9 23  
 17

52938#

1  
 2 13 16 19  
 24 10  
 12 23 13 19  
 21 4 21 9  
 3 17 3 15  
 11 5 11 4  
 6 18 5 18  
 22 8 22 8  
 14 7 9 20 14 6 7 23  
 15 17

61991#

1  
 2 12 20 16  
 24 10  
 13 19  
 21 9  
 3 15  
 11 4  
 6 18  
 22 8  
 14 6 7 23  
 17

69902#

1  
 2 11 22 15  
 24 8  
 14 19 15 23  
 20 9 21 12  
 4 18 3 14  
 13 6 9 8  
 3 16 5 7  
 23 22 11  
 10 7 12 21 16 4 13 17  
 17 19

78373#

1  
 2 10 20 18  
 24 6  
 15 23  
 21 12  
 3 14  
 9 8  
 5 7  
 22 11  
 16 4 13 17  
 19

86931#

1  
 2 9 21 18  
 24 5  
 16 23 17 15  
 20 12 19 16  
 4 15 5 4  
 11 8 11 10  
 3 7 3 9  
 22 10  
 13 6 14 17 20 14 6 7 23  
 19 21

97513#

1  
 2 8 22 18  
 24 12  
 17 15  
 19 16  
 5 4  
 11 10  
 3 9  
 20 13  
 14 6 7 23  
 21

107974#

2 7 1  
 24 21 20 6  
 18 22 19 23  
 19 10 16 15  
 5 14 8 11  
 9 3 12 7  
 4 15 3 5  
 23 16 17 14  
 13 12 8 17 10 18  
 11

119730#

2 6 1 22 20 4  
 24 23  
 19 16 15  
 8 11  
 12 7  
 3 5  
 17 14  
 13 9 10 18  
 21

131758#

2 5 1 22 21 8  
 24 19 21 17  
 20 4 18 7  
 18 17 5 8  
 6 11 9 10  
 9 16 2 16  
 3 23 7 13  
 12 10 13 15 19  
 14

145627#

3 4 1 20 23 12  
 24 17  
 21 7  
 5 8  
 11 9 10  
 16 2 16  
 22 13  
 14 11 6 19  
 15

159756#

4 3 1 23 20 15  
 24 11 23 13  
 22 8 15 7  
 16 11 8 6  
 6 10 9 12  
 10 12 9 19  
 2 19 3 17  
 21 17 19 10 11  
 13 18 5 14 16 20  
 9

175701#

5 2 1 22 21 14  
 24 13  
 23 8  
 15 8  
 6 7  
 9 12  
 3 19 17  
 19 16 10 4 20 11  
 18

190989#

5 2 1 22 21 17  
 23 10  
 24 8  
 13 4  
 9 12  
 7 20  
 6 16  
 19 16 18  
 15 14 3 18  
 11

[Type n2=1]

207028#

23 1 22 14 12 6  
 3 8 24 7  
 24 11 3 13  
 4 21 20 9  
 20 18 5 22  
 5 13 18 8  
 17 10 2 17  
 15 7 19 9 2  
 16

207314#

23 1 21 10 16 12  
 4 7  
 24 3 13  
 20 5 22  
 18 18 8  
 6 17  
 19 15 14 2  
 11

208669#

20  
 21 1 11 17  
 5 7  
 24 12  
 2 16  
 22 10 22  
 6 14 3  
 18 8 21  
 9 23  
 13 19 15 3  
 4

210282#

19  
 20 1 17 12  
 6 4  
 24 10  
 2 11  
 22 23  
 14 3 13  
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213472#

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333178#

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347903#

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379881#

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