Classifications of D-classes in the semigroup $M_n(F)$ of all $n \times n$ Boolean matrices over $F = \{0, 1\}$

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Abstract

We classify the D-classes in the semigroup $M_5(F)$ of all 5×5 Boolean matrices over $F = \{0, 1\}$.

1. 서 론

Kim [4] initiated a new class of semigroup $M_n(K)$, (the semigroups of the $n \times n$ fuzzy matrices over $K = \{ r_i \in [0, 1]: i = 0, 1, 2, \cdots, m \}$ and Kim [6] studi- ed a class of semigroups $M_n(S)$ of the $n \times n$ Boolean matrices over the set $S = [a, b)$ of the interval, where a and b are two real numbers such that $a < b$. The number of all D-classes in the semi- group $M_2(K)$ is given by Theorem [5] and Kim [7] found the D- classes in $M_n(F)$ for $n = 1, 2, 3, 4$. $M_n(F)$ denotes the set of all $n \times n$ matrices over $F = \{0, 1\}$. For $a, b \in F$, define $a + b = \max\{a, b\}$ and $ab = \min\{a, b\}$. Under the oper- ations $a + b$ and ab, $M_n(F)$ forms a multiplicative sem- igroup (see [1],[4]) and we call it the semigroup of the $n \times n$ Boolean matrices over $F = \{0, 1\}$. Since the semi- group $M_n(F)$ is the matrix representation of the semi- group B_n of the binary relations on the set X with n elements, we may identify $M_n(F)$ with B_n for finding all D- classes. Finding all D-classes in $M_n(F)$ is an unso- lved problem for $n \geq 5$. In this paper, we give all D- classes in $M_5(F)$

2. Preliminaries

In this section, we give some definitions which will be used in later section.

Let $F = \{0, 1\}$ and $M_n(F)$ denotes the semigroup of all $n \times n$ Boolean matrices over F.

Definition 2-1. Let $A, B \in M_n(F)$. If there exist X, Y, U, V in $M_n(F)$ such that $AX = C, CY = A,$, $UC = B,$ and $VB = C$. we say that A is equivalent to B and often write $A \sim_D B$.

Theorem 2-2[3]. Let $F = \{0, 1\}$ and let $M_n(F)$ be the semigroup of all $n \times n$ Boolean matrices over F. Then $\sim_D$ is an equivalence relation on $M_n(F)$.

Definition 2-3[2]. Let $M_n(F)$ be the semigroup of all $n \times n$ Boolean matrices over $F = \{0, 1\}$. We define $D_A = \{ B \in M_n(F) : A \sim_D B \}$ and we call it the D- class of $M_n(F)$ containing A.

Definition 2-4. Let $M_n(F)$ be the semigroup of all $n \times n$ Boolean matrices over $F = \{0, 1\}$. An element $A \in M_n(F)$ is called regular if $AXA = A$ for some X in $M_n(F)$.

Definition 2-5[7]. Let $M_n(F)$ be the semigroup of all $n \times n$ Boolean matrices over $F = \{0, 1\}$. Define a set $V_n(F) = \{ (x_0 x_1 \cdots x_{n-1}) : x_i \in F \}$. For $(x_0 x_1 \cdots x_{n-1}) \in V_n(F)$, we define $m(x_0 x_1 \cdots x_{n-1}) = m_i = \sum_{i=0}^{n-1} x_i 2^i$ and we shall say that the name of $(x_0 x_1 \cdots x_{n-1})$ is m_i.

Example 2-6. Let $(10101) \in V_5(F)$. We call (10101) 21 and we write $m(10101) = 21 = 1 \cdot 2^0 + 0 \cdot 2^1 + 1 \cdot 2^2 + 0 \cdot 2^3 + 1 \cdot 2^4$.

For $A = (a_{ij}) \in M_n(F)$, we denote by A_i the i- th row of A. Since $A_i \in V_n(F)$, there exists m_i such that $m(A_i) = m_i$.

Definition 2-7. Let $A \in M_n(F)$ and let A_i be the i-th row of A. Let $m_i = m(A_i)$ be the name of A_i. We call A $(m_1, m_2, \cdots, m_n)$ and write

$$A = (m_1, m_2, \cdots, m_n).$$

Example 2-8. Let $A = \begin{pmatrix} 0 & 1 & 1 \\ 1 & 1 & 0 \\ 0 & 1 & 0 \end{pmatrix} \in M_3(F)$.

Since $m(A_1) = m(011) = 6$, $m(A_2) = m(110) = 3$, $m(A_3) = m(010) = 2$, we can write $A = (6, 3, 2)$.

Notation. We shall have the following notation :
$32(1, 3, 5, 10)$, $r = 4 = c, NR$, $n = 576$

The above notation means that the D-class in $M_4(F)$ containing

$A = \begin{pmatrix} 1000 \\ 1100 \\ 1010 \\ 0101 \end{pmatrix}$ [ie., $m(A) = (1, 3, 5, 10)$] has 576 ($n = 576$)

elements, is non regular(NR) and 32th $D-$class in a table for $M_4(F)$. As we noted above the name A is $(1, 3, 5, 10)$, $r = 4$ means that the row rank of A is equal to 4, and $c = 4$ means that the column rank of A is equal to 4.

3. Tables of $D-$classes

In this section, we have D -classes tables.

Table 1[7]. $M_1(F)$ has 2 D -classes
$1(0), r = 0, \ c = 0, R, \ n = 1$
$2(1), \ r = 1, c = 1, \ R, \ n = 1.$

Table 2[7]. $M_2(F)$ has 4 D -classes
$1(0, 0), r = 0 = c, R, n = 1,$
$2(1, 0), r = 1 = c, R, n = 9,$
$3(1, 2), r = 2 = c, R, n = 2,$
$4(1, 3), r = 2 = c, R, n = 4.$

Table 3[7]. $M_3(F)$ has 11 D -classes
$1(0, 0, 0), r = 0 = c, R, n = 1,$
$2(1, 0, 0), r = 1 = c, R, n = 49,$
$3(1, 2, 0), r = 1 = c, R, n = 162,$
$4(1, 3, 0), r = 2 = c, R, n = 144,$
$5(1, 2, 4), r = 3 = c, R, n = 6,$
$6(1, 2, 5), r = 3 = c, R, n = 36,$
$7(1, 2, 7), r = 3 = c, R, n = 18,$
$8(1, 3, 5), r = 3 = c, R, n = 18,$
$9(1, 3, 7), r = 3 = c, R, n = 36,$
$10(1, 3, 6), r = 3 = c, NR, n = 36,$
$11(3, 5, 6), r = 3 = c, NR, n = 6.$

Table 4[7]. $M_4(F)$ has 60 D -classes
$1(0, 0, 0, 0), r = 0 = c, R, n = 1$
$2(1, 0, 0, 0), r = 1 = c, R, n = 225,$
$3(1, 2, 0, 0), r = 2 = c, R, n = 6050,$
$4(1, 3, 0, 0), r = 2 = c, R, n = 2500,$

$5(1, 2, 4, 0), r = 3 = c, R, n = 4056,$
$6(1, 2, 5, 0), r = 3 = c, R, n = 11664,$
$7(1, 2, 7, 0), r = 3 = c, R, n = 3528,$
$8(1, 3, 5, 0), r = 3 = c, R, n = 3528,$
$9(1, 3, 6, 0), r = 3 = c, NR, n = 7056,$
$10(1, 3, 7, 0), r = 3 = c, R, n = 3600,$
$11(3, 5, 6, 0), r = 3 = c, NR, n = 1176,$
$12(3, 5, 10, 0), r = 3, c = 4, NR, n = 1584,$
$13(3, 5, 14, 0), r = 3, c = 4, NR, n = 1296,$
$14(1, 2, 4, 8), r = 4 = c, R, n = 24,$
$15(1, 2, 4, 9), r = 4 = c, R, n = 288,$
$16(1, 2, 4, 11), r = 4 = c, R, n = 288,$
$17(1, 2, 4, 15), r = 4 = c, R, n = 96,$
$18(1, 2, 5, 6), r = 4, c = 3, NR, n = 1584,$
$19(1, 2, 5, 9), r = 4 = c, R, n = 288,$
$20(1, 2, 5, 10), r = 4 = c, R, n = 288,$
$21(1, 2, 5, 11), r = 4 = c, R, n = 576,$
$22(1, 2, 5, 12), r = 4 = c, R, n = 576,$
$23(1, 2, 5, 13), r = 4 = c, R, n = 576,$
$24(1, 2, 5, 14), r = 4 = c, NR, n = 576,$
$25(1, 2, 5, 15), r = 4 = c, R, n = 576,$
$26(1, 2, 7, 11), r = 4 = c, R, n = 144,$
$27(1, 2, 7, 12), r = 4 = c, NR, n = 288,$
$28(1, 2, 7, 13), r = 4 = c, NR, n = 576,$
$29(1, 2, 7, 15), r = 4 = c, R, n = 288,$
$30(1, 2, 5, 6), r = 4, c = 3, NR, n = 1296,$
$31(1, 3, 5, 9), r = 4 = c, R, n = 96,$
$32(1, 3, 5, 10), r = 4 = c, NR, n = 576,$
$33(1, 3, 5, 11), r = 4 = c, R, n = 576,$
$34(1, 3, 5, 14), r = 4 = c, NR, n = 288,$
$35(1, 3, 5, 15), r = 4 = c, R, n = 288,$
$36(1, 3, 6, 10), r = 4 = c, NR, n = 288,$
$37(1, 3, 6, 11), r = 4 = c, NR, n = 576,$
$38(1, 3, 6, 12), r = 4 = c, NR, n = 576,$
$39(1, 3, 6, 13), r = 4 = c, NR, n = 576,$
$40(1, 3, 6, 14), r = 4 = c, NR, n = 576,$
$41(1, 3, 6, 15), r = 4 = c, NR, n = 576,$
$42(1.3.7.11), r = 4 = c, R, n = 288,$
$43(1, 3, 7, 12), r = 4 = c, NR, n = 576,$
$44(1, 3, 7, 13), r = 4 = c, NR, n = 576,$
$45(1, 3, 7, 14), r = 4 = c, NR, n = 576,$
$46(1, 3, 7, 15), r = 4 = c, R, n = 576,$
$47(1, 6, 10, 12), r = 4 = c, NR, n = 96,$
$48(1, 6, 10, 13), r = 4 = c, NR, n = 288,$
$49(1, 6, 11, 13), r = 4 = c, NR, n = 288,$
$50(1, 7, 11, 13), r = 4 = c, NR, n = 96,$
$51(3, 5, 6, 9), r = 4 = c, NR, n = 288,$
$52(3, 5, 6, 11), r = 4 = c, NR, n = 72,$
$53(3, 5, 6, 15), r = 4 = c, NR, n = 96,$
$54(3, 5, 9, 14), r = 4 = c, NR, n = 96,$
$55(3, 5, 10, 12), r = 4 = c, NR, n = 72,$
$56(3, 5, 10, 13), r = 4 = c, NR, n = 576,$
$57(3, 5, 11, 14), r = 4 = c, NR, n = 576,$
$58(3, 7, 12, 13), r = 4 = c, NR, n = 288,$

$59(3,7,13,14)$, $r=4=c$, NR, $n=288$,
$60(7,11,13,14)$, $r=4=c$, NR, $n=24$.

Table 5. $M_5(F)$ has 877 D-classes.

$1(30,23,9,5,3)$, $r=5=c$, NR, $n=7200$
$2(29,23,10,5,3)$, $r=5=c$, NR, $n=14400$
$3(29,28,11,7,0)$, $r=4$, $c=5$, NR, $n=36000$
$4(30,13,10,6,1)$, $r=5=c$, NR, $n=7200$
$5(25,14,5,3,0)$, $r=4$, $c=5$, NR, $n=57600$
$6(30,29,10,6,1)$, $r=5=c$, NR, $n=7200$
$7(30,10,5,3,1)$, $r=5=c$, NR, $n=14400$
$8(19,13,10,5,3)$, $r=5=c$, NR, $n=14400$
$9(26,13,11,6,1)$, $r=5=c$, NR, $n=14400$
$10(27,22,13,3,0)$, $r=4$, $c=5$, NR, $n=43200$
$11(25,9,4,2,1)$, $r=5=c$, R, $n=7200$
$12(18,13,10,6,1)$, $r=5=c$, NR, $n=7200$
$13(28,11,6,1,0)$, $r=4$, $c=5$, NR, $n=115200$
$14(10,5,2,1,0)$, $r=4=c$, R, $n=352800$
$15(23,12,6,3,1)$, $r=5=c$, NR, $n=14400$
$16(13,10,5,3,0)$, $r=4=c$, NR, $n=518400$
$17(23,11,6,5,3)$, $r=5=c$, NR, $n=7200$
$18(20,10,5,2,1)$, $r=5=c$, NR, $n=14400$
$19(23,13,6,3,1)$, $r=5=c$, NR, $n=14400$
$20(31,15,6,3,1)$, $r=5=c$, NR, $n=14400$
$21(21,11,6,3,1)$, $r=5=c$, NR, $n=14400$
$22(30,14,5,3,0)$, $r=4$, $c=5$, NR, $n=43200$
$23(29,15,6,3,1)$, $r=5=c$, NR, $n=14400$
$24(12,11,5,2,1)$, $r=5$, $c=4$, NR, $n=129600$
$25(6,3,1,0,0)$, $r=3=c$, NR, $n=562500$
$26(24,22,11,6,1)$, $r=5=c$, NR, $n=14400$
$27(28,11,5,3,0)$, $r=4$, $c=5$, NR, $n=100800$
$28(26,14,5,3,0)$, $r=4$, $c=5$, NR, $n=115200$
$29(29,11,6,5,3)$, $r=5=c$, NR, $n=14400$
$30(24,13,5,2,1)$, $r=5=c$, NR, $n=14400$
$31(28,23,10,5,3)$, $r=5=c$, NR, $n=14400$
$32(19,12,10,5,3)$, $r=5=c$, NR, $n=7200$
$33(30,28,11,5,3)$, $r=5=c$, NR, $n=14400$
$34(30,12,7,3,1)$, $r=5=c$, NR, $n=14400$
$35(22,9,4,2,1)$, $r=5=c$, R, $n=7200$
$36(20,13,10,6,1)$, $r=5=c$, NR, $n=14400$
$37(30,9,4,2,1)$, $r=5=c$, NR, $n=7200$
$38(25,20,10,6,1)$, $r=5=c$, NR, $n=7200$
$39(10,5,3,0,0)$, $r=3$, $c=4$, NR, $n=549000$
$40(11,5,3,1,0)$, $r=4=c$, R, $n=360000$
$41(21,11,7,3,1)$, $r=5=c$, NR, $n=14400$
$42(30,13,7,3,0)$, $r=4$, $c=5$, NR, $n=72000$
$43(26,22,13,11,7)$, $r=5=c$, NR, $n=7200$
$44(9,5,3,1,0)$, $r=4=c$, R, $n=117600$
$45(5,3,1,0,0)$, $r=3=c$, R, $n=281250$
$46(10,5,3,1,0)$, $r=4=c$, NR, $n=518400$
$47(9,5,2,1,0)$, $r=4=c$, R, $n=460800$
$48(23,12,7,3,1)$, $r=5=c$, NR, $n=14400$
$49(26,25,11,5,3)$, $r=5=c$, NR, $n=14400$
$50(28,15,7,3,1)$, $r=5=c$, NR, $n=14400$

$51(13,10,6,1,0)$, $r=4=c$, NR, $n=352800$
$52(27,15,4,2,1)$, $r=5=c$, NR, $n=7200$
$53(26,25,13,7,3)$, $r=5=c$, NR, $n=14400$
$54(30,15,7,3,1)$, $r=5=c$, NR, $n=14400$
$55(30,12,5,2,1)$, $r=5=c$, NR, $n=14400$
$56(23,12,10,5,3)$, $r=5=c$, NR, $n=7200$
$57(25,13,6,3,1)$, $r=5=c$, NR, $n=14400$
$58(29,28,15,7,3)$, $r=5=c$, NR, $n=14400$
$59(11,5,2,1,0)$, $r=4=c$, R, $n=518400$
$60(13,12,7,3,0)$, $r=4=c$, NR, $n=115200$
$61(26,11,5,3,0)$, $r=4$, $c=5$, NR, $n=100800$
$62(18,9,5,3,0)$, $r=4$, $c=5$, NR, $n=79200$
$63(27,9,6,5,3)$, $r=5=c$, NR, $n=14400$
$64(27,12,5,2,1)$, $r=5=c$, NR, $n=14400$
$65(14,6,3,1,0)$, $r=4=c$, NR, $n=360000$
$66(29,27,11,6,1)$, $r=5=c$, NR, $n=14400$
$67(23,14,11,5,3)$, $r=5=c$, NR, $n=14400$
$68(12,5,2,1,0)$, $r=4=c$, NR, $n=921600$
$69(27,22,21,12,3)$, $r=5=c$, NR, $n=7200$
$70(26,9,6,5,3)$, $r=5=c$, NR, $n=14400$
$71(20,10,6,1,0)$, $r=4$, $c=5$, NR, $n=86400$
$72(24,14,11,5,3)$, $r=5=c$, NR, $n=14400$
$73(30,14,5,2,1)$, $r=5=c$, NR, $n=14400$
$74(22,21,10,5,3)$, $r=5=c$, NR, $n=14400$
$75(29,10,5,3,0)$, $r=4$, $c=5$, NR, $n=100800$
$76(24,11,6,1,0)$, $r=4$, $c=5$, NR, $n=64800$
$77(13,7,3,1,0)$, $r=4=c$, NR, $n=230400$
$78(21,10,6,1,0)$, $r=4$, $c=5$, NR, $n=129600$
$79(21,14,11,7,1)$, $r=5=c$, NR, $n=14400$
$80(30,11,5,3,0)$, $r=4$, $c=5$, NR, $n=86400$
$81(27,22,12,3,1)$, $r=5=c$, NR, $n=14400$
$82(24,9,4,2,1)$, $r=5=c$, NR, $n=7200$
$83(27,14,5,3,0)$, $r=4$, $c=5$, NR, $n=86400$
$84(14,11,5,3,0)$, $r=4=c$, NR, $n=360000$
$85(13,7,2,1,0)$, $r=4=c$, NR, $n=360000$
$86(23,10,5,3,0)$, $r=4$, $c=5$, NR, $n=100800$
$87(31,12,7,3,1)$, $r=5=c$, NR, $n=14400$
$88(26,13,7,3,0)$, $r=4$, $c=5$, NR, $n=86400$
$89(28,13,11,7,3)$, $r=5=c$, NR, $n=7200$
$90(23,14,5,3,0)$, $r=4$, $c=5$, NR, $n=43200$
$91(14,5,3,0,0)$, $r=3$, $c=4$, NR, $n=295200$
$92(27,24,15,6,1)$, $r=5=c$, NR, $n=7200$
$93(28,26,14,7,1)$, $r=5=c$, NR, $n=7200$
$94(22,11,5,3,0)$, $r=4$, $c=5$, NR, $n=100800$
$95(21,11,6,1,0)$, $r=4$, $c=5$, NR, $n=50400$
$96(12,7,2,1,0)$, $r=4=c$, NR, $n=352800$
$97(6,5,3,1,0)$, $r=4$, $c=3$, NR, $n=295200$
$98(25,15,7,3,1)$, $r=5=c$, NR, $n=14400$
$99(25,23,11,6,1)$, $r=5=c$, NR, $n=14400$
$100(19,10,5,3,0)$, $r=4$, $c=5$, NR, $n=64800$
$101(13,11,6,5,3)$, $r=5$, $c=4$, NR, $n=43200$
$102(5,2,1,0,0)$, $r=3=c$, R, $n=1512900$
$103(13,11,5,3,1)$, $r=5$, $c=4$, NR, $n=43200$
$104(30,15,5,3,1)$, $r=5=c$, NR, $n=7200$

105(27,15,7,3,1), $r = 5 = c$, NR, $n = 14400$
106(21,12,6,3,1), $r = 5 = c$, NR, $n = 14400$
107(26,21,11,6,1), $r = 5 = c$, NR, $n = 14400$
108(26,22,11,5,3), $r = 5 = c$, NR, $n = 14400$
109(22,9,5,2,1), $r = 5 = c$, NR, $n = 14400$
110(29,10,5,2,1), $r = 5 = c$, NR, $n = 14400$
111(28,27,11,6,1), $r = 5 = c$, NR, $n = 14400$
112(24,11,5,3,1), $r = 5 = c$, NR, $n = 14400$
113(25,14,5,2,1), $r = 5 = c$, NR, $n = 14400$
114(29,11,7,3,1), $r = 5 = c$, NR, $n = 7200$
115(28,23,10,6,1), $r = 5 = c$, NR, $n = 14400$
116(26,15,5,3,0), $r = 4, c = 5$, NR, $n = 86400$
117(30,21,11,7,0), $r = 4, c = 5$, NR, $n = 43200$
118(29,19,10,6,1), $r = 5 = c$, NR, $n = 7200$
119(26,21,14,13,3), $r = 5 = c$, NR, $n = 7200$
120(30,14,6,3,1), $r = 5 = c$, NR, $n = 14400$
121(27,12,6,3,1), $r = 5 = c$, NR, $n = 14400$
122(25,12,6,3,1), $r = 5 = c$, NR, $n = 14400$
123(30,29,13,7,3), $r = 5 = c$, NR, $n = 14400$
124(27,14,7,3,1), $r = 5 = c$, NR, $n = 14400$
125(27,11,5,2,1), $r = 5 = c$, R, $n = 14400$
126(28,13,7,3,0), $r = 4, c = 5$, NR, $n = 86400$
127(15,6,5,2,1), $r = 5, c = 4$, NR, $n = 43200$
128(14,11,6,3,1), $r = 5, c = 4$, NR, $n = 86400$
129(21,10,5,3,0), $r = 4, c = 5$, NR, $n = 115200$
130(27,13,11,6,1), $r = 5 = c$, NR, $n = 14400$
131(30,10,6,3,1), $r = 5 = c$, NR, $n = 7200$
132(29,10,6,1,0), $r = 4, c = 5$, NR, $n = 57600$
133(18,14,9,5,3), $r = 5 = c$, NR, $n = 7200$
134(29,26,11,6,1), $r = 5 = c$, NR, $n = 14400$
135(13,11,6,1,0), $r = 4 = c$, NR, $n = 180000$
136(21,11,7,1,0), $r = 4, c = 5$, NR, $n = 43200$
137(26,21,11,7,1), $r = 5 = c$, NR, $n = 14400$
138(27,21,12,3,1), $r = 5 = c$, NR, $n = 14400$
139(28,12,7,3,1), $r = 5 = c$, NR, $n = 14400$
140(25,11,6,1,0), $r = 4, c = 5$, NR, $n = 100800$
141(30,25,15,7,3), $r = 5 = c$, NR, $n = 14400$
142(24,22,13,7,3), $r = 5 = c$, NR, $n = 7200$
143(28,14,5,2,1), $r = 5 = c$, NR, $n = 14400$
144(26,13,7,2,1), $r = 5 = c$, NR, $n = 14400$
145(29,21,10,5,3), $r = 5 = c$, NR, $n = 14400$
146(26,13,11,5,3), $r = 5 = c$, NR, $n = 14400$
147(28,27,23,13,3), $r = 5 = c$, NR, $n = 7200$
148(27,21,12,2,1), $r = 5 = c$, NR, $n = 14400$
149(26,11,6,3,1), $r = 5 = c$, NR, $n = 14400$
150(13,10,6,3,1), $r = 5, c = 4$, NR, $n = 57600$
151(27,25,15,6,1), $r = 5 = c$, NR, $n = 14400$
152(26,21,12,3,0), $r = 4, c = 5$, NR, $n = 32400$
153(22,13,5,2,1), $r = 5 = c$, NR, $n = 14400$
154(19,10,6,3,1), $r = 5 = c$, NR, $n = 7200$
155(22,19,13,11,7), $r = 5 = c$, NR, $n = 7200$
156(26,23,15,5,3), $r = 5 = c$, NR, $n = 7200$
157(29,13,7,2,1), $r = 5 = c$, NR, $n = 14400$
158(25,20,10,5,3), $r = 5 = c$, NR, $n = 7200$

159(26,14,6,3,1), $r = 5 = c$, NR, $n = 14400$
160(27,21,11,7,1), $r = 5 = c$, NR, $n = 14400$
161(14,13,6,3,1), $r = 5, c = 4$, NR, $n = 86400$
163(22,13,7,3,0), $r = 4, c = 5$, NR, $n = 43200$
162(29,13,10,5,3), $r = 5 = c$, NR, $n = 14400$
164(15,6,3,1,0), $r = 4 = c$, NR, $n = 230400$
165(29,11,4,2,1), $r = 5 = c$, NR, $n = 14400$
166(27,21,11,6,1), $r = 5 = c$, NR, $n = 14400$
167(26,21,11,7,0), $r = 4, c = 5$, NR, $n = 50400$
168(13,6,5,2,1), $r = 5, c = 4$, NR, $n = 100800$
169(27,14,5,3,1), $r = 5 = c$, NR, $n = 14400$
170(29,23,11,6,1), $r = 5 = c$, NR, $n = 14400$
171(15,5,3,1,0), $r = 4 = c$, R, $n = 115200$
172(24,12,7,3,1), $r = 5 = c$, NR, $n = 14400$
173(27,11,5,3,1), $r = 5 = c$, R, $n = 14400$
174(25,12,5,2,1), $r = 5 = c$, NR, $n = 14400$
175(9,6,5,3,1), $r = 5, c = 4$, NR, $n = 57600$
176(29,14,11,7,1), $r = 5 = c$, NR, $n = 7200$
177(30,25,11,6,1), $r = 5 = c$, NR, $n = 14400$
178(31,15,5,2,1), $r = 5 = c$, R, $n = 14400$
179(12,7,3,1,0), $r = 4 = c$, NR, $n = 360000$
180(26,24,15,5,3), $r = 5 = c$, NR, $n = 14400$
181(30,29,23,11,7), $r = 5 = c$, NR, $n = 7200$
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184(12,11,6,3,1), $r = 5, c = 4$, NR, $n = 115200$
185(25,15,6,5,3), $r = 5 = c$, NR, $n = 7200$
186(31,14,13,7,3), $r = 5 = c$, NR, $n = 7200$
187(7,3,1,0,0), $r = 3 = c$, R, $n = 152100$
188(29,12,7,2,1), $r = 5 = c$, NR, $n = 14400$
189(25,14,11,6,1), $r = 5 = c$, NR, $n = 14400$
190(28,25,13,7,3), $r = 5 = c$, NR, $n = 14400$
191(11,4,2,1,0), $r = 4 = c$, R, $n = 460800$
192(25,21,12,2,1), $r = 5 = c$, NR, $n = 7200$
193(3,1,0,0,0), $r = 2 = c$, R, $n = 32400$
194(26,14,5,3,1), $r = 5 = c$, NR, $n = 14400$
195(27,15,5,2,1), $r = 5 = c$, NR, $n = 14400$
196(25,13,7,3,1), $r = 5 = c$, NR, $n = 14400$
197(25,14,13,7,3), $r = 5 = c$, NR, $n = 14400$
198(31,12,10,5,3), $r = 5 = c$, NR, $n = 1800$
199(21,11,6,5,3), $r = 5 = c$, NR, $n = 7200$
200(30,23,15,5,3), $r = 5 = c$, NR, $n = 3600$
201(23,15,6,3,1), $r = 5 = c$, NR, $n = 7200$
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203(25,14,7,3,1), $r = 5 = c$, NR, $n = 14400$
204(20,12,7,2,1), $r = 5 = c$, NR, $n = 3600$
205(26,21,13,2,1), $r = 5 = c$, NR, $n = 7200$
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207(12,9,5,2,1), $r = 5, c = 4$, NR, $n = 72000$
208(27,15,6,5,3), $r = 5 = c$, NR, $n = 7200$
209(26,22,14,5,3), $r = 5 = c$, NR, $n = 7200$
210(28,13,6,3,1), $r = 5 = c$, NR, $n = 14400$
211(24,13,10,5,3), $r = 5 = c$, NR, $n = 14400$
212(28,22,11,5,3), $r = 5 = c$, NR, $n = 14400$

$213(9,4,2,1,0)$, $r=4=c$, R, $n=720000$
$214(29,11,7,1,0)$, $r=4$, $c=5$, NR, $n=36000$
$215(23,13,7,2,1)$, $r=5=c$, NR, $n=14400$
$216(22,14,5,2,1)$, $r=5=c$, NR, $n=7200$
$217(13,6,3,1,0)$, $r=4=c$, NR, $n=360000$
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$219(23,12,5,2,1)$, $r=5=c$, NR, $n=14400$
$220(24,15,5,3,1)$, $r=5=c$, NR, $n=7200$
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$227(21,10,5,3,1)$, $r=5=c$, NR, $n=14400$
$228(30,27,15,5,3)$, $r=5=c$, NR, $n=14400$
$229(25,22,11,5,3)$, $r=5=c$, NR, $n=14400$
$230(19,9,5,2,1)$, $r=5=c$, R, $n=7200$
$231(22,10,5,3,0)$, $r=4$, $c=5$, NR, $n=129600$
$232(27,22,13,2,1)$, $r=5=c$, NR, $n=7200$
$233(23,11,7,3,1)$, $r=5=c$, R, $n=14400$
$234(30,11,5,2,1)$, $r=5=c$, NR, $n=14400$
$235(28,11,7,1,0)$, $r=4$, $c=5$, NR, $n=43200$
$236(30,29,15,7,3)$, $r=5=c$, NR, $n=7200$
$237(28,10,6,3,1)$, $r=5=c$, NR, $n=7200$
$238(22,14,7,3,1)$, $r=5=c$, NR, $n=7200$
$239(13,5,2,1,0)$, $r=4=c$, R, $n=518400$
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$241(25,20,12,2,1)$, $r=5=c$, NR, $n=7200$
$242(18,9,4,2,1)$, $r=5=c$, R, $n=7200$
$243(28,26,11,5,3)$, $r=5=c$, NR, $n=14400$
$244(14,13,7,3,0)$, $r=4=c$, NR, $n=115200$
$245(29,26,14,6,1)$, $r=5=c$, NR, $n=14400$
$246(14,9,6,5,3)$, $r=5$, $c=4$, NR, $n=57600$
$247(26,13,10,5,3)$, $r=5=c$, NR, $n=14400$
$248(29,15,7,2,1)$, $r=5=c$, NR, $n=14400$
$249(20,10,5,3,0)$, $r=4$, $c=5$, NR, $n=72000$
$250(22,9,5,3,0)$, $r=4$, $c=5$, NR, $n=64800$
$251(30,21,11,5,3)$, $r=5=c$, NR, $n=7200$
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$253(28,25,11,5,3)$, $r=5=c$, NR, $n=14400$
$254(29,13,6,3,1)$, $r=5=c$, NR, $n=14400$
$255(6,5,2,1,0)$, $r=4$, $c=3$, NR, $n=549000$
$256(26,20,10,6,1)$, $r=5=c$, NR, $n=14400$
$257(28,13,7,2,1)$, $r=5=c$, NR, $n=14400$
$258(24,14,5,3,0)$, $r=4$, $c=5$, NR, $n=64800$
$259(30,27,14,5,3)$, $r=5=c$, NR, $n=14400$
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$262(31,13,10,6,1)$, $r=5=c$, NR, $n=7200$
$263(14,5,2,1,0)$, $r=4=c$, NR, $n=518400$
$264(21,11,5,3,1)$, $r=5=c$, R, $n=7200$
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$266(28,21,13,7,3)$, $r=5=c$, NR, $n=7200$

$267(26,15,7,3,1)$, $r=5=c$, NR, $n=14400$
$268(27,22,13,3,1)$, $r=5=c$, NR, $n=14400$
$269(28,11,6,5,3)$, $r=5=c$, NR, $n=7200$
$270(30,27,21,11,7)$, $r=5=c$, NR, $n=14400$
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$272(28,21,10,5,3)$, $r=5=c$, NR, $n=14400$
$273(29,26,11,5,3)$, $r=5=c$, NR, $n=14400$
$274(30,23,13,7,3)$, $r=5=c$, NR, $n=14400$
$275(30,11,6,3,1)$, $r=5=c$, NR, $n=14400$
$276(14,13,5,2,1)$, $r=5$, $c=4$, NR, $n=100800$
$277(31,13,6,3,1)$, $r=5=c$, NR, $n=14400$
$278(25,22,10,5,3)$, $r=5=c$, NR, $n=7200$
$279(30,29,12,7,3)$, $r=5=c$, NR, $n=7200$
$280(18,10,6,3,1)$, $r=5=c$, NR, $n=2400$
$281(29,21,10,6,1)$, $r=5=c$, NR, $n=14400$
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$283(28,25,15,7,3)$, $r=5=c$, NR, $n=14400$
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$285(28,26,21,13,3)$, $r=5=c$, NR, $n=7200$
$286(27,22,10,5,3)$, $r=5=c$, NR, $n=14400$
$287(24,13,7,3,1)$, $r=5=c$, NR, $n=14400$
$288(11,6,5,3,0)$, $r=4=c$, NR, $n=180000$
$289(29,14,5,2,1)$, $r=5=c$, NR, $n=14400$
$290(28,10,5,3,0)$, $r=4$, $c=5$, NR, $n=64800$
$291(22,12,6,3,1)$, $r=5=c$, NR, $n=14400$
$292(21,10,5,2,1)$, $r=5=c$, R, $n=14400$
$293(28,22,11,7,1)$, $r=5=c$, NR, $n=14400$
$294(24,12,7,2,1)$, $r=5=c$, NR, $n=7200$
$295(15,7,3,1,0)$, $r=4=c$, R, $n=129600$
$296(21,12,7,3,1)$, $r=5=c$, NR, $n=14400$
$297(30,29,10,5,3)$, $r=5=c$, NR, $n=7200$
$298(27,25,14,6,1)$, $r=5=c$, NR, $n=14400$
$299(28,11,7,2,1)$, $r=5=c$, NR, $n=3600$
$300(25,19,11,6,1)$, $r=5=c$, NR, $n=7200$
$301(2,1,0,0,0)$, $r=2=c$, R, $n=162450$
$302(26,14,7,3,1)$, $r=5=c$, NR, $n=14400$
$303(27,11,6,5,3)$, $r=5=c$, NR, $n=7200$
$304(29,22,10,5,3)$, $r=5=c$, NR, $n=14400$
$305(25,11,4,2,1)$, $r=5=c$, NR, $n=14400$
$306(28,26,14,5,3)$, $r=5=c$, NR, $n=7200$
$307(29,22,11,6,1)$, $r=5=c$, NR, $n=14400$
$308(29,9,5,2,1)$, $r=5=c$, R, $n=7200$
$309(27,22,14,5,3)$, $r=5=c$, NR, $n=7200$
$310(30,13,7,3,1)$, $r=5=c$, NR, $n=14400$
$311(15,5,2,1,0)$, $r=4=c$, R, $n=360000$
$312(21,9,5,2,1)$, $r=5=c$, R, $n=14400$
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$316(28,21,11,7,3)$, $r=5=c$, NR, $n=14400$
$317(28,27,11,5,3)$, $r=5=c$, NR, $n=14400$
$318(27,10,5,3,1)$, $r=5=c$, NR, $n=14400$
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$321(26, 12, 7, 3, 1)$, $r = 5 = c$, NR, $n = 14400$

$322(31, 14, 5, 3, 0)$, $r = 4$, $c = 5$, NR, $n = 36000$

$323(27, 21, 13, 3, 1)$, $r = 5 = c$, NR, $n = 7200$

$324(12, 10, 5, 3, 0)$, $r = 4 = c$, NR, $n = 115200$

$325(29, 26, 15, 6, 1)$, $r = 5 = c$, NR, $n = 14400$

$326(29, 19, 11, 7, 1)$, $r = 5 = c$, NR, $n = 2400$

$327(30, 14, 5, 3, 1)$, $r = 5 = c$, NR, $n = 7200$

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$331(21, 20, 11, 7, 3)$, $r = 5 = c$, NR, $n = 14400$

$332(9, 6, 5, 3, 0)$, $r = 4 = c$, NR, $n = 352800$

$333(22, 14, 11, 5, 3)$, $r = 5 = c$, NR, $n = 14400$

$334(30, 13, 11, 7, 3)$, $r = 5 = c$, NR, $n = 7200$

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$337(23, 13, 11, 7, 1)$, $r = 5 = c$, NR, $n = 7200$

$338(23, 12, 10, 6, 1)$, $r = 5 = c$, NR, $n = 7200$

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$344(28, 14, 13, 7, 3)$, $r = 5 = c$, NR, $n = 7200$

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$346(26, 13, 7, 3, 1)$, $r = 5 = c$, NR, $n = 14400$

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$348(27, 22, 9, 5, 3)$, $r = 5 = c$, NR, $n = 14400$

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$356(25, 22, 13, 7, 3)$, $r = 5 = c$, NR, $n = 14400$

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$358(31, 9, 5, 3, 1)$, $r = 5 = c$, R, $n = 2400$

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$366(23, 14, 7, 3, 1)$, $r = 5 = c$, NR, $n = 14400$

$367(21, 14, 11, 5, 3)$, $r = 5 = c$, NR, $n = 14400$

$368(23, 11, 5, 3, 1)$, $r = 5 = c$, R, $n = 14400$

$369(25, 9, 6, 5, 3)$, $r = 5 = c$, NR, $n = 7200$

$370(27, 13, 7, 3, 1)$, $r = 5 = c$, NR, $n = 14400$

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$376(29, 22, 10, 6, 1)$, $r = 5 = c$, NR, $n = 14400$

$377(27, 13, 5, 2, 1)$, $r = 5 = c$, NR, $n = 14400$

$378(22, 10, 6, 3, 1)$, $r = 5 = c$, NR, $n = 14400$

$379(28, 26, 15, 6, 1)$, $r = 5 = c$, NR, $n = 7200$

$380(24, 10, 5, 3, 1)$, $r = 5 = c$, NR, $n = 14400$

$381(22, 12, 10, 5, 3)$, $r = 5 = c$, NR, $n = 3600$

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$384(29, 14, 7, 3, 1)$, $r = 5 = c$, NR, $n = 14400$

$385(29, 15, 5, 2, 1)$, $r = 5 = c$, NR, $n = 14400$

$386(30, 23, 14, 5, 3)$, $r = 5 = c$, NR, $n = 7200$

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$388(29, 13, 7, 3, 1)$, $r = 5 = c$, NR, $n = 14400$

$389(25, 11, 5, 2, 1)$, $r = 5 = c$, NR, $n = 14400$

$390(21, 12, 5, 2, 1)$, $r = 5 = c$, NR, $n = 14400$

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$392(23, 14, 6, 3, 1)$, $r = 5 = c$, NR, $n = 14400$

$393(20, 13, 10, 5, 3)$, $r = 5 = c$, NR, $n = 14400$

$394(27, 12, 7, 2, 1)$, $r = 5 = c$, NR, $n = 7200$

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$396(28, 11, 5, 3, 1)$, $r = 5 = c$, NR, $n = 14400$

$397(24, 11, 6, 3, 1)$, $r = 5 = c$, NR, $n = 14400$

$398(23, 13, 11, 6, 1)$, $r = 5 = c$, NR, $n = 7200$

$399(28, 19, 11, 5, 3)$, $r = 5 = c$, NR, $n = 7200$

$400(4, 2, 1, 0, 0)$, $r = 3 = c$, R, $n = 1083750$

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$407(30, 27, 23, 13, 3)$, $r = 5 = c$, NR, $n = 7200$

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$410(21, 13, 7, 2, 1)$, $r = 5 = c$, NR, $n = 7200$

$411(20, 9, 5, 2, 1)$, $r = 5 = c$, NR, $n = 14400$

$412(29, 22, 11, 7, 1)$, $r = 5 = c$, NR, $n = 14400$

$413(31, 15, 6, 5, 3)$, $r = 5 = c$, NR, $n = 2400$

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$416(30, 12, 6, 3, 1)$, $r = 5 = c$, NR, $n = 14400$

$417(23, 15, 5, 2, 1)$, $r = 5 = c$, R, $n = 7200$

$418(30, 21, 11, 6, 1)$, $r = 5 = c$, NR, $n = 7200$

$419(31, 10, 5, 3, 0)$, $r = 4$, $c = 5$, NR, $n = 43200$

$420(27, 21, 14, 13, 3)$, $r = 5 = c$, NR, $n = 14400$

$421(14, 9, 5, 3, 0)$, $r = 4 = c$, NR, $n = 117600$

$422(28, 11, 4, 2, 1)$, $r = 5 = c$, NR, $n = 7200$

$423(23, 14, 5, 2, 1)$, $r = 5 = c$, NR, $n = 14400$

$424(7, 2, 1, 0, 0)$, $r = 3 = c$, R, $n = 281250$

$425(24, 11, 6, 5, 3)$, $r = 5 = c$, NR, $n = 7200$

$426(24, 14, 5, 2, 1)$, $r = 5 = c$, NR, $n = 14400$

$427(27, 13, 7, 2, 1)$, $r = 5 = c$, NR, $n = 14400$

$428(28, 15, 6, 3, 1)$, $r = 5 = c$, NR, $n = 14400$

$429(28, 19, 11, 6, 1)$, $r = 5 = c$, NR, $n = 7200$
$430(31, 9, 4, 2, 1)$, $r = 5 = c$, R, $n = 7200$
$431(30, 29, 11, 7, 0)$, $r = 4$, $c = 5$, NR, $n = 18000$
$432(29, 22, 13, 7, 3)$, $r = 5 = c$, NR, $n = 14400$
$433(28, 24, 13, 7, 3)$, $r = 5 = c$, NR, $n = 7200$
$434(19, 11, 5, 2, 1)$, $r = 5 = c$, R, $n = 7200$
$435(30, 22, 11, 5, 3)$, $r = 5 = c$, NR, $n = 14400$
$436(29, 28, 23, 11, 7)$, $r = 5 = c$, NR, $n = 14400$
$437(30, 23, 13, 11, 7)$, $r = 5 = c$, NR, $n = 7200$
$438(26, 20, 12, 3, 1)$, $r = 5 = c$, NR, $n = 7200$
$439(25, 15, 5, 2, 1)$, $r = 5 = c$, NR, $n = 14400$
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$442(31, 13, 12, 7, 3)$, $r = 5 = c$, NR, $n = 7200$
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$445(24, 15, 7, 3, 1)$, $r = 5 = c$, NR, $n = 14400$
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$447(29, 28, 12, 7, 3)$, $r = 5 = c$, NR, $n = 14400$
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$463(14, 11, 7, 3, 1)$, $r = 5 = c$, NR, $n = 36000$
$464(25, 15, 5, 3, 1)$, $r = 5 = c$, NR, $n = 7200$
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$467(21, 13, 10, 6, 1)$, $r = 5 = c$, NR, $n = 14400$
$468(28, 26, 13, 7, 3)$, $r = 5 = c$, NR, $n = 14400$
$469(24, 13, 6, 3, 1)$, $r = 5 = c$, NR, $n = 14400$
$470(31, 13, 7, 2, 1)$, $r = 5 = c$, NR, $n = 14400$
$471(19, 11, 5, 3, 1)$, $r = 5 = c$, R, $n = 7200$
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$474(27, 15, 5, 3, 1)$, $r = 5 = c$, NR, $n = 14400$
$475(26, 21, 10, 6, 1)$, $r = 5 = c$, NR, $n = 14400$
$476(25, 15, 6, 3, 1)$, $r = 5 = c$, NR, $n = 14400$
$477(29, 22, 11, 5, 3)$, $r = 5 = c$, NR, $n = 14400$
$478(30, 13, 10, 5, 3)$, $r = 5 = c$, NR, $n = 14400$
$479(14, 9, 5, 3, 1)$, $r = 5$, $c = 4$, NR, $n = 19200$
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$481(31, 14, 7, 3, 1)$, $r = 5 = c$, NR, $n = 14400$
$482(30, 13, 11, 5, 3)$, $r = 5 = c$, NR, $n = 7200$

$483(27, 25, 14, 7, 1)$, $r = 5 = c$, NR, $n = 14400$
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$485(25, 21, 10, 6, 1)$, $r = 5 = c$, NR, $n = 7200$
$486(29, 27, 15, 6, 1)$, $r = 5 = c$, NR, $n = 7200$
$487(24, 13, 11, 6, 1)$, $r = 5 = c$, NR, $n = 7200$
$488(30, 21, 13, 7, 3)$, $r = 5 = c$, NR, $n = 7200$
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$490(28, 14, 11, 5, 3)$, $r = 5 = c$, NR, $n = 14400$
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$494(23, 11, 6, 3, 1)$, $r = 5 = c$, NR, $n = 14400$
$495(30, 28, 11, 7, 1)$, $r = 5 = c$, NR, $n = 7200$
$496(21, 14, 11, 6, 1)$, $r = 5 = c$, NR, $n = 14400$
$497(15, 6, 5, 3, 1)$, $r = 5$, $c = 4$, NR, $n = 36000$
$498(14, 9, 4, 2, 1)$, $r = 5$, $c = 4$, NR, $n = 79200$
$499(11, 7, 3, 1, 0)$, $r = 4 = c$, R, $n = 115200$
$500(10, 9, 6, 5, 3)$, $r = 5$, $c = 4$, NR, $n = 32400$
$501(27, 23, 13, 3, 1)$, $r = 5 = c$, NR, $n = 7200$
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$503(25, 15, 7, 2, 1)$, $r = 5 = c$, NR, $n = 14400$
$504(23, 14, 13, 11, 7)$, $r = 5 = c$, NR, $n = 2400$
$505(23, 13, 10, 6, 1)$, $r = 5 = c$, NR, $n = 14400$
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$507(31, 12, 7, 2, 1)$, $r = 5 = c$, NR, $n = 7200$
$508(24, 11, 4, 2, 1)$, $r = 5 = c$, NR, $n = 7200$
$509(29, 14, 13, 7, 3)$, $r = 5 = c$, NR, $n = 14400$
$510(31, 11, 5, 2, 1)$, $r = 5 = c$, R, $n = 14400$
$511(26, 23, 11, 5, 3)$, $r = 5 = c$, NR, $n = 14400$
$512(24, 13, 7, 2, 1)$, $r = 5 = c$, NR, $n = 14400$
$513(29, 12, 6, 3, 1)$, $r = 5 = c$, NR, $n = 14400$
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$516(27, 22, 13, 7, 3)$, $r = 5 = c$, NR, $n = 7200$
$517(28, 10, 5, 3, 1)$, $r = 5 = c$, NR, $n = 14400$
$518(29, 12, 5, 2, 1)$, $r = 5 = c$, NR, $n = 14400$
$519(30, 9, 5, 3, 1)$, $r = 5 = c$, NR, $n = 2400$
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$521(26, 21, 12, 3, 1)$, $r = 5 = c$, NR, $n = 14400$
$522(22, 13, 10, 6, 1)$, $r = 5 = c$, NR, $n = 14400$
$523(26, 21, 11, 7, 3)$, $r = 5 = c$, NR, $n = 7200$
$524(26, 25, 14, 6, 1)$, $r = 5 = c$, NR, $n = 14400$
$525(30, 9, 5, 2, 1)$, $r = 5 = c$, NR, $n = 7200$
$526(31, 12, 6, 3, 1)$, $r = 5 = c$, NR, $n = 14400$
$527(23, 11, 7, 2, 1)$, $r = 5 = c$, R, $n = 7200$
$528(23, 13, 12, 7, 3)$, $r = 5 = c$, NR, $n = 14400$
$529(31, 14, 11, 5, 3)$, $r = 5 = c$, NR, $n = 14400$
$530(27, 22, 13, 11, 7)$, $r = 5 = c$, NR, $n = 14400$
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$533(28, 21, 12, 7, 3)$, $r = 5 = c$, NR, $n = 14400$
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$535(22, 13, 11, 6, 1)$, $r = 5 = c$, NR, $n = 7200$
$536(29, 27, 14, 6, 1)$, $r = 5 = c$, NR, $n = 7200$

$537(24, 20, 10, 6, 1)$, $r = 5 = c$, NR, $n = 1800$

$538(28, 27, 13, 7, 3)$, $r = 5 = c$, NR, $n = 14400$

$539(23, 15, 7, 2, 1)$, $r = 5 = c$, R, $n = 3600$

$540(19, 10, 5, 3, 1)$, $r = 5 = c$, NR, $n = 14400$

$541(23, 13, 5, 2, 1)$, $r = 5 = c$, R, $n = 14400$

$542(15, 6, 5, 3, 0)$, $r = 4 = c$, NR, $n = 38400$

$543(22, 14, 9, 5, 3)$, $r = 5 = c$, NR, $n = 7200$

$544(27, 14, 5, 2, 1)$, $r = 5 = c$, NR, $n = 14400$

$545(22, 19, 10, 5, 3)$, $r = 5 = c$, NR, $n = 14400$

$546(27, 15, 6, 3, 1)$, $r = 5 = c$, NR, $n = 14400$

$547(18, 10, 5, 3, 1)$, $r = 5 = c$, NR, $n = 7200$

$548(28, 25, 12, 7, 3)$, $r = 5 = c$, NR, $n = 14400$

$549(14, 13, 11, 7, 0)$, $r = 4 = c$, NR, $n = 9600$

$550(13, 11, 4, 2, 1)$, $r = 5$, $c = 4$, NR, $n = 64800$

$551(22, 12, 5, 2, 1)$, $r = 5 = c$, NR, $n = 14400$

$552(28, 18, 9, 5, 3)$, $r = 5 = c$, NR, $n = 7200$

$553(22, 13, 11, 7, 0)$, $r = 4$, $c = 5$, NR, $n = 43200$

$554(30, 13, 7, 2, 1)$, $r = 5 = c$, NR, $n = 14400$

$555(25, 24, 11, 5, 3)$, $r = 5 = c$, NR, $n = 14400$

$556(22, 11, 7, 3, 1)$, $r = 5 = c$, NR, $n = 14400$

$557(28, 26, 11, 6, 1)$, $r = 5 = c$, NR, $n = 14400$

$558(20, 11, 5, 2, 1)$, $r = 5 = c$, NR, $n = 14400$

$559(26, 25, 14, 5, 3)$, $r = 5 = c$, NR, $n = 14400$

$560(28, 11, 5, 2, 1)$, $r = 5 = c$, NR, $n = 14400$

$561(30, 14, 7, 3, 1)$, $r = 5 = c$, NR, $n = 14400$

$562(13, 11, 7, 3, 1)$, $r = 5$, $c = 4$, NR, $n = 36000$

$563(25, 23, 14, 5, 3)$, $r = 5 = c$, NR, $n = 7200$

$564(24, 14, 7, 3, 1)$, $r = 5 = c$, NR, $n = 14400$

$565(25, 10, 5, 3, 1)$, $r = 5 = c$, NR, $n = 14400$

$566(19, 11, 7, 2, 1)$, $r = 5 = c$, R, $n = 1200$

$567(31, 11, 6, 5, 3)$, $r = 5 = c$, NR, $n = 7200$

$568(28, 23, 11, 5, 3)$, $r = 5 = c$, NR, $n = 14400$

$569(27, 13, 10, 5, 3)$, $r = 5 = c$, NR, $n = 14400$

$570(29, 11, 6, 3, 1)$, $r = 5 = c$, NR, $n = 14400$

$571(13, 11, 7, 1, 0)$, $r = 4 = c$, NR, $n = 38400$

$572(14, 5, 3, 1, 0)$, $r = 4 = c$, NR, $n = 180000$

$573(13, 10, 5, 2, 1)$, $r = 5$, $c = 4$, NR, $n = 115200$

$574(30, 25, 21, 13, 3)$, $r = 5 = c$, NR, $n = 2400$

$575(26, 12, 6, 3, 1)$, $r = 5 = c$, NR, $n = 14400$

$576(14, 13, 7, 2, 1)$, $r = 5$, $c = 4$, NR, $n = 43200$

$577(26, 23, 14, 5, 3)$, $r = 5 = c$, NR, $n = 14400$

$578(20, 11, 7, 2, 1)$, $r = 5 = c$, NR, $n = 7200$

$579(25, 15, 4, 2, 1)$, $r = 5 = c$, NR, $n = 7200$

$580(26, 25, 15, 7, 3)$, $r = 5 = c$, NR, $n = 7200$

$581(30, 9, 6, 5, 3)$, $r = 5 = c$, NR, $n = 7200$

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$583(22, 11, 5, 2, 1)$, $r = 5 = c$, NR, $n = 14400$

$584(14, 10, 5, 3, 1)$, $r = 5$, $c = 4$, NR, $n = 100800$

$585(21, 13, 6, 3, 1)$, $r = 5 = c$, NR, $n = 7200$

$586(19, 9, 4, 2, 1)$, $r = 5 = c$, R, $n = 14400$

$587(28, 13, 10, 5, 3)$, $r = 5 = c$, NR, $n = 14400$

$588(30, 13, 6, 3, 1)$, $r = 5 = c$, NR, $n = 14400$

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$591(28, 26, 15, 7, 1)$, $r = 5 = c$, NR, $n = 7200$

$592(20, 11, 6, 3, 1)$, $r = 5 = c$, NR, $n = 14400$

$593(24, 14, 5, 3, 1)$, $r = 5 = c$, NR, $n = 7200$

$594(30, 29, 11, 7, 3)$, $r = 5 = c$, NR, $n = 3600$

$595(24, 11, 5, 2, 1)$, $r = 5 = c$, NR, $n = 14400$

$596(19, 13, 11, 6, 1)$, $r = 5 = c$, NR, $n = 14400$

$597(22, 13, 11, 7, 3)$, $r = 5 = c$, NR, $n = 14400$

$598(30, 27, 13, 7, 3)$, $r = 5 = c$, NR, $n = 14400$

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$604(23, 8, 4, 2, 1)$, $r = 5 = c$, R, $n = 2400$

$605(31, 11, 7, 3, 1)$, $r = 5 = c$, R, $n = 7200$

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$612(31, 24, 20, 3, 0)$, $r = 4$, $c = 5$, R, $n = 7200$

$613(31, 15, 7, 3, 1)$, $r = 5 = c$, R, $n = 14400$

$614(28, 22, 10, 5, 3)$, $r = 5 = c$, NR, $n = 14400$

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$616(28, 22, 10, 6, 1)$, $r = 5 = c$, NR, $n = 14400$

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$622(13, 11, 7, 2, 1)$, $r = 5$, $c = 4$, NR, $n = 43200$

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$624(30, 25, 13, 7, 3)$, $r = 5 = c$, NR, $n = 14400$

$625(24, 9, 6, 5, 3)$, $r = 5 = c$, NR, $n = 7200$

$626(25, 11, 6, 5, 3)$, $r = 5 = c$, NR, $n = 14400$

$627(23, 15, 5, 3, 1)$, $r = 5 = c$, R, $n = 3600$

$628(19, 11, 6, 3, 1)$, $r = 5 = c$, NR, $n = 7200$

$629(30, 29, 11, 6, 1)$, $r = 5 = c$, NR, $n = 14400$

$630(26, 23, 13, 7, 3)$, $r = 5 = c$, NR, $n = 14400$

$631(28, 14, 11, 6, 1)$, $r = 5 = c$, NR, $n = 14400$

$632(30, 11, 5, 3, 1)$, $r = 5 = c$, NR, $n = 14400$

$633(28, 23, 11, 7, 1)$, $r = 5 = c$, NR, $n = 14400$

$634(28, 23, 11, 6, 1)$, $r = 5 = c$, NR, $n = 14400$

$635(19, 13, 11, 7, 1)$, $r = 5 = c$, NR, $n = 7200$

$636(30, 26, 13, 7, 3)$, $r = 5 = c$, NR, $n = 14400$

$637(29, 10, 6, 3, 1)$, $r = 5 = c$, NR, $n = 7200$

$638(30, 11, 7, 3, 1)$, $r = 5 = c$, NR, $n = 7200$

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$642(30, 13, 11, 6, 1)$, $r = 5 = c$, NR, $n = 7200$

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$648(21,11,5,2,1)$, $r=5=c$, R, $n=14400$
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$653(25,21,13,3,1)$, $r=5=c$, NR, $n=2400$
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$656(22,18,9,5,3)$, $r=5=c$, NR, $n=14400$
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$659(28,10,5,2,1)$, $r=5=c$, NR, $n=7200$
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$661(29,11,5,3,1)$, $r=5=c$, NR, $n=14400$
$662(23,11,5,2,1)$, $r=5=c$, R, $n=14400$
$663(25,21,11,7,1)$, $r=5=c$, NR, $n=1800$
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$667(19,11,4,2,1)$, $r=5=c$, R, $n=3600$
$668(21,11,7,2,1)$, $r=5=c$, NR, $n=14400$
$669(23,10,5,2,1)$, $r=5=c$, R, $n=14400$
$670(29,15,7,3,1)$, $r=5=c$, NR, $n=14400$
$671(31,13,11,7,1)$, $r=5=c$, NR, $n=2400$
$672(27,13,12,7,3)$, $r=5=c$, NR, $n=14400$
$673(30,15,5,2,1)$, $r=5=c$, NR, $n=14400$
$674(23,9,5,3,1)$, $r=5=c$, R, $n=7200$
$675(26,21,12,7,3)$, $r=5=c$, NR, $n=14400$
$676(30,25,12,7,3)$, $r=5=c$, NR, $n=14400$
$677(30,24,11,5,3)$, $r=5=c$, NR, $n=14400$
$678(29,28,11,7,3)$, $r=5=c$, NR, $n=7200$
$679(24,15,4,2,1)$, $r=5=c$, NR, $n=2400$
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$684(27,21,13,2,1)$, $r=5=c$, NR, $n=7200$
$685(14,11,5,2,1)$, $r=5$, $c=4$, NR, $n=100800$
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$877(0,0,0,0,0)$, $r=0=c$, R, $n=1$

참 고 문 헌

[1] Kim K, Butler, On (0,1)-matrix semigroups, Semigroup Forum 3(1971), 74-79.

[2] A. H. Clifford and G. B. Preston, The Algebraic theory of Semigroups, Vol. 1 , Math. Suveys, New York,1964.

[3] C. B. Kim, A study of the semigroup B_n of the binary relations on a set X with n elements, Ph.D. thesis, Yonsei University, Korea, 1985.

[4] Jin Bai Kim, A certain matrix semigroup, Mathematical Japoni- ca 22-5(1978), 519-522 : MR 58-960.

[5] Jin Bai Kim, Combinatorial properties of a fuzzy matrix semigroup, Proceedings of the 10th Southeastern Conference of Combinatorics, Graph theory and Computing, Utilitas Math. Publi- shing Inc., Winnipeg, Manitoba, Canada (1979), 569-676. MR 81i-05012.

[6] Jin Bai Kim, Inverses of Boolean matrices, Bulletin of the Institute of Math., Academia Sinica 12-2(1984), 125-128.

[7] Jin Bai Kim, Tables of $D-$classes in the semi-group B_n of the binary relations on a set X with n elements, Bull. Korean Math. Soc. Vol. 20, No.1(1985), 9-13.

[8] Jin Bai Kim, and C. B. Kim, On fuzzy ma-trices(Fuzzy Linear Algebra), Proc. of fuzzy logic programming OUCC 89(1989), 182-192.

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