

代数学幾何学 (A/B) 計算演習 [問題] (2009/07/09)

問. 次の連立一次方程式を解きなさい

Q.1

$$\begin{cases} 4x_1 & & & + 2x_4 = 8 \\ - 5x_1 + 2x_2 - 3x_3 - x_4 = -14 \\ - 2x_1 + 2x_2 - 2x_3 - 2x_4 = -2 \\ 4x_1 + 3x_2 + 3x_3 + 2x_4 = -19 \end{cases}$$

Q.2

$$\begin{cases} x_1 + x_2 + 6x_3 + 2x_4 + 2x_5 = 13 \\ - 6x_1 - 5x_2 + 3x_3 - 11x_4 + 4x_5 = -52 \\ 4x_1 + 5x_2 - 4x_3 + 9x_4 + 2x_5 = 9 \\ - 4x_1 + x_2 - 5x_3 - 3x_4 - 2x_5 = -6 \end{cases}$$

Q.3

$$\begin{cases} 6x_1 + 12x_2 - 2x_3 = -4 \\ - 6x_1 - 12x_2 + 6x_3 = 0 \\ 6x_1 + 12x_2 + 6x_3 = -12 \end{cases}$$

Q.4

$$\begin{cases} - 5x_1 + x_2 - x_3 + 2x_4 & = -2 \\ & - 5x_2 - 5x_3 + x_4 + 6x_5 = 55 \\ 3x_1 + 6x_2 + 6x_3 + 4x_4 - 3x_5 = -7 \\ & - 6x_2 - 2x_3 - x_4 - x_5 = -10 \\ - 6x_1 - 2x_2 + 6x_3 + 3x_4 + 5x_5 = -24 \end{cases}$$

Q.5

$$\begin{cases} - 2x_1 + 3x_2 + 3x_3 & = 3 \\ 4x_1 - 5x_2 + 6x_3 + 4x_4 = 64 \\ - 4x_1 - 4x_2 - 2x_3 + 4x_4 = -2 \\ x_1 + 4x_2 - 3x_3 + 2x_4 = -14 \\ - 6x_1 + 8x_2 - 3x_3 - 4x_4 = 6 \end{cases}$$

Q.6

$$\begin{cases} - 2x_1 + 4x_2 - 4x_3 = 2 \\ - x_1 - 6x_2 + x_3 = 24 \\ x_1 + 3x_2 + 5x_3 = -30 \end{cases}$$

Q.7

$$\begin{cases} -2x_1 & -3x_3 & -3x_4 & +5x_5 & = & -6 \\ -5x_1 & & & -x_4 & & = & -9 \\ 2x_1 & -3x_3 & +2x_4 & -4x_5 & = & 30 \\ -4x_1 & +3x_3 & -6x_4 & -x_5 & = & 18 \\ & -5x_3 & -5x_4 & & = & 50 \end{cases}$$

Q.8

$$\begin{cases} -6x_1 & -6x_2 & -6x_3 & = & -48 \\ x_1 & +x_2 & +2x_3 & = & 8 \\ -5x_1 & +5x_2 & -2x_3 & = & -20 \\ -7x_1 & -7x_2 & -8x_3 & = & -56 \end{cases}$$

Q.9

$$\begin{cases} -6x_2 & +3x_3 & -6x_4 & = & 72 \\ 4x_2 & -3x_3 & +4x_4 & = & -50 \\ -4x_2 & +2x_3 & +5x_4 & = & -6 \\ -x_2 & -6x_3 & +x_4 & = & -13 \end{cases}$$

Q.10

$$\begin{cases} 5x_1 & +10x_2 & +4x_3 & -5x_4 & -2x_5 & = & -22 \\ 2x_1 & +4x_2 & +5x_3 & -5x_4 & +x_5 & = & -19 \\ 3x_1 & +6x_2 & -x_3 & +4x_4 & & = & 5 \\ -3x_1 & -6x_2 & +4x_3 & -5x_4 & & = & -22 \\ 2x_1 & +4x_2 & +2x_3 & +5x_4 & +x_5 & = & -11 \\ -5x_1 & -10x_2 & -x_3 & & -x_5 & = & -3 \end{cases}$$

Q.11

$$\begin{cases} -x_1 & & +4x_3 & +4x_4 & +5x_5 & = & -23 \\ 6x_1 & +5x_2 & +3x_3 & -6x_4 & +6x_5 & = & -30 \\ 2x_1 & -4x_2 & +4x_3 & +3x_4 & +5x_5 & = & -62 \\ 5x_1 & & +2x_3 & +6x_4 & -x_5 & = & -25 \end{cases}$$

代数学幾何学 (A/B) 計算演習 [解答] (2009/07/09)

A.1

$$\begin{cases} 4x_1 & & & + 2x_4 = 8 \\ -5x_1 + 2x_2 - 3x_3 - x_4 = -14 \\ -2x_1 + 2x_2 - 2x_3 - 2x_4 = -2 \\ 4x_1 + 3x_2 + 3x_3 + 2x_4 = -19 \end{cases}$$

$$\left(\begin{array}{cccc|c} 4 & 0 & 0 & 2 & 8 \\ -5 & 2 & -3 & -1 & -14 \\ -2 & 2 & -2 & -2 & -2 \\ 4 & 3 & 3 & 2 & -19 \end{array} \right)$$

1行目を $\frac{1}{4}$ 倍

$$\left(\begin{array}{cccc|c} 1 & 0 & 0 & \frac{1}{2} & 2 \\ -5 & 2 & -3 & -1 & -14 \\ -2 & 2 & -2 & -2 & -2 \\ 4 & 3 & 3 & 2 & -19 \end{array} \right)$$

2行目に1行目を5倍して、加える

$$\left(\begin{array}{cccc|c} 1 & 0 & 0 & \frac{1}{2} & 2 \\ 0 & 2 & -3 & \frac{3}{2} & -4 \\ -2 & 2 & -2 & -2 & -2 \\ 4 & 3 & 3 & 2 & -19 \end{array} \right)$$

3行目に1行目を2倍して、加える

$$\left(\begin{array}{cccc|c} 1 & 0 & 0 & \frac{1}{2} & 2 \\ 0 & 2 & -3 & \frac{3}{2} & -4 \\ 0 & 2 & -2 & -1 & 2 \\ 4 & 3 & 3 & 2 & -19 \end{array} \right)$$

4行目に1行目を -4 倍して、加える

$$\left(\begin{array}{cccc|c} 1 & 0 & 0 & \frac{1}{2} & 2 \\ 0 & 2 & -3 & \frac{3}{2} & -4 \\ 0 & 2 & -2 & -1 & 2 \\ 0 & 3 & 3 & 0 & -27 \end{array} \right)$$

2行目を $\frac{1}{2}$ 倍

$$\left(\begin{array}{cccc|c} 1 & 0 & 0 & \frac{1}{2} & 2 \\ 0 & 1 & -\frac{3}{2} & \frac{3}{4} & -2 \\ 0 & 2 & -2 & -1 & 2 \\ 0 & 3 & 3 & 0 & -27 \end{array} \right)$$

3行目に2行目を -2 倍して、加える

$$\left(\begin{array}{cccc|c} 1 & 0 & 0 & \frac{1}{2} & 2 \\ 0 & 1 & -\frac{3}{2} & \frac{3}{4} & -2 \\ 0 & 0 & 1 & -\frac{5}{2} & 6 \\ 0 & 3 & 3 & 0 & -27 \end{array} \right)$$

4行目に2行目を -3 倍して、加える

$$\left(\begin{array}{cccc|c} 1 & 0 & 0 & \frac{1}{2} & 2 \\ 0 & 1 & -\frac{3}{2} & \frac{3}{4} & -2 \\ 0 & 0 & 1 & -\frac{5}{2} & 6 \\ 0 & 0 & \frac{15}{2} & -\frac{9}{4} & -21 \end{array} \right)$$

4行目に3行目を $-\frac{15}{2}$ 倍して、加える

$$\left(\begin{array}{cccc|c} 1 & 0 & 0 & \frac{1}{2} & 2 \\ 0 & 1 & -\frac{3}{2} & \frac{3}{4} & -2 \\ 0 & 0 & 1 & -\frac{5}{2} & 6 \\ 0 & 0 & 0 & \frac{33}{2} & -66 \end{array} \right)$$

4行目を $\frac{2}{33}$ 倍

$$\left(\begin{array}{cccc|c} 1 & 0 & 0 & \frac{1}{2} & 2 \\ 0 & 1 & -\frac{3}{2} & \frac{3}{4} & -2 \\ 0 & 0 & 1 & -\frac{5}{2} & 6 \\ 0 & 0 & 0 & 1 & -4 \end{array} \right)$$

3行目に4行目を $\frac{5}{2}$ 倍して、加える

$$\left(\begin{array}{cccc|c} 1 & 0 & 0 & \frac{1}{2} & 2 \\ 0 & 1 & -\frac{3}{2} & \frac{3}{4} & -2 \\ 0 & 0 & 1 & 0 & -4 \\ 0 & 0 & 0 & 1 & -4 \end{array} \right)$$

2行目に4行目を $-\frac{3}{4}$ 倍して、加える

$$\left(\begin{array}{cccc|c} 1 & 0 & 0 & \frac{1}{2} & 2 \\ 0 & 1 & -\frac{3}{2} & 0 & 1 \\ 0 & 0 & 1 & 0 & -4 \\ 0 & 0 & 0 & 1 & -4 \end{array} \right)$$

1行目に4行目を $-\frac{1}{2}$ 倍して、加える

$$\left(\begin{array}{cccc|c} 1 & 0 & 0 & 0 & 4 \\ 0 & 1 & -\frac{3}{2} & 0 & 1 \\ 0 & 0 & 1 & 0 & -4 \\ 0 & 0 & 0 & 1 & -4 \end{array} \right)$$

2行目に3行目を $\frac{3}{2}$ 倍して、加える

$$\left(\begin{array}{cccc|c} 1 & 0 & 0 & 0 & 4 \\ 0 & 1 & 0 & 0 & -5 \\ 0 & 0 & 1 & 0 & -4 \\ 0 & 0 & 0 & 1 & -4 \end{array} \right)$$

$$\begin{cases} x_1 = 4 \\ x_2 = -5 \\ x_3 = -4 \\ x_4 = -4 \end{cases}$$

A.2

$$\begin{cases} x_1 + x_2 + 6x_3 + 2x_4 + 2x_5 = 13 \\ -6x_1 - 5x_2 + 3x_3 - 11x_4 + 4x_5 = -52 \\ 4x_1 + 5x_2 - 4x_3 + 9x_4 + 2x_5 = 9 \\ -4x_1 + x_2 - 5x_3 - 3x_4 - 2x_5 = -6 \end{cases}$$

$$\left(\begin{array}{ccccc|c} 1 & 1 & 6 & 2 & 2 & 13 \\ -6 & -5 & 3 & -11 & 4 & -52 \\ 4 & 5 & -4 & 9 & 2 & 9 \\ -4 & 1 & -5 & -3 & -2 & -6 \end{array} \right)$$

2行目に1行目を6倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & 1 & 6 & 2 & 2 & 13 \\ 0 & 1 & 39 & 1 & 16 & 26 \\ 4 & 5 & -4 & 9 & 2 & 9 \\ -4 & 1 & -5 & -3 & -2 & -6 \end{array} \right)$$

3行目に1行目を -4 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & 1 & 6 & 2 & 2 & 13 \\ 0 & 1 & 39 & 1 & 16 & 26 \\ 0 & 1 & -28 & 1 & -6 & -43 \\ -4 & 1 & -5 & -3 & -2 & -6 \end{array} \right)$$

4行目に1行目を4倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & 1 & 6 & 2 & 2 & 13 \\ 0 & 1 & 39 & 1 & 16 & 26 \\ 0 & 1 & -28 & 1 & -6 & -43 \\ 0 & 5 & 19 & 5 & 6 & 46 \end{array} \right)$$

3行目に2行目を -1 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & 1 & 6 & 2 & 2 & 13 \\ 0 & 1 & 39 & 1 & 16 & 26 \\ 0 & 0 & -67 & 0 & -22 & -69 \\ 0 & 5 & 19 & 5 & 6 & 46 \end{array} \right)$$

4行目に2行目を -5 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & 1 & 6 & 2 & 2 & 13 \\ 0 & 1 & 39 & 1 & 16 & 26 \\ 0 & 0 & -67 & 0 & -22 & -69 \\ 0 & 0 & -176 & 0 & -74 & -84 \end{array} \right)$$

3行目を $-\frac{1}{67}$ 倍

$$\left(\begin{array}{ccccc|c} 1 & 1 & 6 & 2 & 2 & 13 \\ 0 & 1 & 39 & 1 & 16 & 26 \\ 0 & 0 & 1 & 0 & \frac{22}{67} & \frac{69}{67} \\ 0 & 0 & -176 & 0 & -74 & -84 \end{array} \right)$$

4行目に3行目を176倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & 1 & 6 & 2 & 2 & 13 \\ 0 & 1 & 39 & 1 & 16 & 26 \\ 0 & 0 & 1 & 0 & \frac{22}{67} & \frac{69}{67} \\ 0 & 0 & 0 & 0 & -\frac{1086}{67} & \frac{6516}{67} \end{array} \right)$$

4列目と5列目を交換

$$\left(\begin{array}{ccccc|c} 1 & 1 & 6 & 2 & 2 & 13 \\ 0 & 1 & 39 & 16 & 1 & 26 \\ 0 & 0 & 1 & \frac{22}{67} & 0 & \frac{69}{67} \\ 0 & 0 & 0 & -\frac{1086}{67} & 0 & \frac{6516}{67} \end{array} \right)$$

4行目を $-\frac{67}{1086}$ 倍

$$\left(\begin{array}{ccccc|c} 1 & 1 & 6 & 2 & 2 & 13 \\ 0 & 1 & 39 & 16 & 1 & 26 \\ 0 & 0 & 1 & \frac{22}{67} & 0 & \frac{69}{67} \\ 0 & 0 & 0 & 1 & 0 & -6 \end{array} \right)$$

3行目に4行目を $-\frac{22}{67}$ 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & 1 & 6 & 2 & 2 & 13 \\ 0 & 1 & 39 & 16 & 1 & 26 \\ 0 & 0 & 1 & 0 & 0 & 3 \\ 0 & 0 & 0 & 1 & 0 & -6 \end{array} \right)$$

2行目に4行目を -16 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & 1 & 6 & 2 & 2 & 13 \\ 0 & 1 & 39 & 0 & 1 & 122 \\ 0 & 0 & 1 & 0 & 0 & 3 \\ 0 & 0 & 0 & 1 & 0 & -6 \end{array} \right)$$

1行目に4行目を -2 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & 1 & 6 & 0 & 2 & 25 \\ 0 & 1 & 39 & 0 & 1 & 122 \\ 0 & 0 & 1 & 0 & 0 & 3 \\ 0 & 0 & 0 & 1 & 0 & -6 \end{array} \right)$$

2行目に3行目を -39 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & 1 & 6 & 0 & 2 & 25 \\ 0 & 1 & 0 & 0 & 1 & 5 \\ 0 & 0 & 1 & 0 & 0 & 3 \\ 0 & 0 & 0 & 1 & 0 & -6 \end{array} \right)$$

1行目に3行目を -6 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & 1 & 0 & 0 & 2 & 7 \\ 0 & 1 & 0 & 0 & 1 & 5 \\ 0 & 0 & 1 & 0 & 0 & 3 \\ 0 & 0 & 0 & 1 & 0 & -6 \end{array} \right)$$

1行目に2行目を -1 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & 0 & 0 & 0 & 1 & 2 \\ 0 & 1 & 0 & 0 & 1 & 5 \\ 0 & 0 & 1 & 0 & 0 & 3 \\ 0 & 0 & 0 & 1 & 0 & -6 \end{array} \right)$$

$$\begin{cases} x_1 = -p_4 + 2 \\ x_2 = -p_4 + 5 \\ x_3 = 3 \\ x_5 = -6 \\ x_4 = p_4 \end{cases}$$

A.3

$$\begin{cases} 6x_1 + 12x_2 - 2x_3 = -4 \\ -6x_1 - 12x_2 + 6x_3 = 0 \\ 6x_1 + 12x_2 + 6x_3 = -12 \end{cases}$$

$$\left(\begin{array}{ccc|c} 6 & 12 & -2 & -4 \\ -6 & -12 & 6 & 0 \\ 6 & 12 & 6 & -12 \end{array} \right)$$

1行目を $\frac{1}{6}$ 倍

$$\left(\begin{array}{ccc|c} 1 & 2 & -\frac{1}{3} & -\frac{2}{3} \\ -6 & -12 & 6 & 0 \\ 6 & 12 & 6 & -12 \end{array} \right)$$

2行目に1行目を6倍して、加える

$$\left(\begin{array}{ccc|c} 1 & 2 & -\frac{1}{3} & -\frac{2}{3} \\ 0 & 0 & 4 & -4 \\ 6 & 12 & 6 & -12 \end{array} \right)$$

3行目に1行目を -6 倍して、加える

$$\left(\begin{array}{ccc|c} 1 & 2 & -\frac{1}{3} & -\frac{2}{3} \\ 0 & 0 & 4 & -4 \\ 0 & 0 & 8 & -8 \end{array} \right)$$

2列目と3列目を交換

$$\left(\begin{array}{ccc|c} 1 & -\frac{1}{3} & 2 & -\frac{2}{3} \\ 0 & 4 & 0 & -4 \\ 0 & 8 & 0 & -8 \end{array} \right)$$

2行目を $\frac{1}{4}$ 倍

$$\left(\begin{array}{ccc|c} 1 & -\frac{1}{3} & 2 & -\frac{2}{3} \\ 0 & 1 & 0 & -1 \\ 0 & 8 & 0 & -8 \end{array} \right)$$

3行目に2行目を -8 倍して、加える

$$\left(\begin{array}{ccc|c} 1 & -\frac{1}{3} & 2 & -\frac{2}{3} \\ 0 & 1 & 0 & -1 \\ 0 & 0 & 0 & 0 \end{array} \right)$$

1行目に2行目を $\frac{1}{3}$ 倍して、加える

$$\left(\begin{array}{ccc|c} 1 & 0 & 2 & -1 \\ 0 & 1 & 0 & -1 \\ 0 & 0 & 0 & 0 \end{array} \right)$$

$$\begin{cases} x_1 = -2p_2 - 1 \\ x_3 = -1 \\ x_2 = p_2 \end{cases}$$

A.4

$$\begin{cases} -5x_1 + x_2 - x_3 + 2x_4 = -2 \\ -5x_2 - 5x_3 + x_4 + 6x_5 = 55 \\ 3x_1 + 6x_2 + 6x_3 + 4x_4 - 3x_5 = -7 \\ -6x_2 - 2x_3 - x_4 - x_5 = -10 \\ -6x_1 - 2x_2 + 6x_3 + 3x_4 + 5x_5 = -24 \end{cases}$$

$$\left(\begin{array}{ccccc|c} -5 & 1 & -1 & 2 & 0 & -2 \\ 0 & -5 & -5 & 1 & 6 & 55 \\ 3 & 6 & 6 & 4 & -3 & -7 \\ 0 & -6 & -2 & -1 & -1 & -10 \\ -6 & -2 & 6 & 3 & 5 & -24 \end{array} \right)$$

1行目を $-\frac{1}{5}$ 倍

$$\left(\begin{array}{ccccc|c} 1 & -\frac{1}{5} & \frac{1}{5} & -\frac{2}{5} & 0 & \frac{2}{5} \\ 0 & -5 & -5 & 1 & 6 & 55 \\ 3 & 6 & 6 & 4 & -3 & -7 \\ 0 & -6 & -2 & -1 & -1 & -10 \\ -6 & -2 & 6 & 3 & 5 & -24 \end{array} \right)$$

3行目に1行目を -3 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & -\frac{1}{5} & \frac{1}{5} & -\frac{2}{5} & 0 & \frac{2}{5} \\ 0 & -5 & -5 & 1 & 6 & 55 \\ 0 & \frac{33}{5} & \frac{27}{5} & \frac{26}{5} & -3 & -\frac{41}{5} \\ 0 & -6 & -2 & -1 & -1 & -10 \\ -6 & -2 & 6 & 3 & 5 & -24 \end{array} \right)$$

5行目に1行目を6倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & -\frac{1}{5} & \frac{1}{5} & -\frac{2}{5} & 0 & \frac{2}{5} \\ 0 & -5 & -5 & 1 & 6 & 55 \\ 0 & \frac{33}{5} & \frac{27}{5} & \frac{26}{5} & -3 & -\frac{41}{5} \\ 0 & -6 & -2 & -1 & -1 & -10 \\ 0 & -\frac{16}{5} & \frac{36}{5} & \frac{3}{5} & 5 & -\frac{108}{5} \end{array} \right)$$

2行目を $-\frac{1}{5}$ 倍

$$\left(\begin{array}{ccccc|c} 1 & -\frac{1}{5} & \frac{1}{5} & -\frac{2}{5} & 0 & \frac{2}{5} \\ 0 & 1 & 1 & -\frac{1}{5} & -\frac{6}{5} & -11 \\ 0 & \frac{33}{5} & \frac{27}{5} & \frac{26}{5} & -3 & -\frac{41}{5} \\ 0 & -6 & -2 & -1 & -1 & -10 \\ 0 & -\frac{16}{5} & \frac{36}{5} & \frac{3}{5} & 5 & -\frac{108}{5} \end{array} \right)$$

3行目に2行目を $-\frac{33}{5}$ 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & -\frac{1}{5} & \frac{1}{5} & -\frac{2}{5} & 0 & \frac{2}{5} \\ 0 & 1 & 1 & -\frac{1}{5} & -\frac{6}{5} & -11 \\ 0 & 0 & -\frac{6}{5} & \frac{163}{25} & \frac{123}{25} & \frac{322}{5} \\ 0 & -6 & -2 & -1 & -1 & -10 \\ 0 & -\frac{16}{5} & \frac{36}{5} & \frac{3}{5} & 5 & -\frac{108}{5} \end{array} \right)$$

4行目に2行目を6倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & -\frac{1}{5} & \frac{1}{5} & -\frac{2}{5} & 0 & \frac{2}{5} \\ 0 & 1 & 1 & -\frac{1}{5} & -\frac{6}{5} & -11 \\ 0 & 0 & -\frac{6}{5} & \frac{163}{25} & \frac{123}{25} & \frac{322}{5} \\ 0 & 0 & 4 & -\frac{11}{5} & -\frac{41}{5} & -76 \\ 0 & -\frac{16}{5} & \frac{36}{5} & \frac{3}{5} & 5 & -\frac{108}{5} \end{array} \right)$$

4行目を $\frac{15}{293}$ 倍

$$\left(\begin{array}{ccccc|c} 1 & -\frac{1}{5} & \frac{1}{5} & -\frac{2}{5} & 0 & \frac{2}{5} \\ 0 & 1 & 1 & -\frac{1}{5} & -\frac{6}{5} & -11 \\ 0 & 0 & 1 & -\frac{163}{30} & -\frac{41}{10} & -\frac{161}{3} \\ 0 & 0 & 0 & 1 & \frac{123}{293} & \frac{2080}{293} \\ 0 & 0 & 0 & \frac{847}{15} & \frac{219}{5} & \frac{1504}{3} \end{array} \right)$$

5行目に2行目を $\frac{16}{5}$ 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & -\frac{1}{5} & \frac{1}{5} & -\frac{2}{5} & 0 & \frac{2}{5} \\ 0 & 1 & 1 & -\frac{1}{5} & -\frac{6}{5} & -11 \\ 0 & 0 & -\frac{6}{5} & \frac{163}{25} & \frac{123}{25} & \frac{322}{5} \\ 0 & 0 & 4 & -\frac{11}{5} & -\frac{41}{5} & -76 \\ 0 & 0 & \frac{52}{5} & -\frac{1}{25} & \frac{29}{25} & -\frac{284}{5} \end{array} \right)$$

5行目に4行目を $-\frac{847}{15}$ 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & -\frac{1}{5} & \frac{1}{5} & -\frac{2}{5} & 0 & \frac{2}{5} \\ 0 & 1 & 1 & -\frac{1}{5} & -\frac{6}{5} & -11 \\ 0 & 0 & 1 & -\frac{163}{30} & -\frac{41}{10} & -\frac{161}{3} \\ 0 & 0 & 0 & 1 & \frac{123}{293} & \frac{2080}{293} \\ 0 & 0 & 0 & 0 & \frac{5888}{293} & \frac{29440}{293} \end{array} \right)$$

3行目を $-\frac{5}{6}$ 倍

$$\left(\begin{array}{ccccc|c} 1 & -\frac{1}{5} & \frac{1}{5} & -\frac{2}{5} & 0 & \frac{2}{5} \\ 0 & 1 & 1 & -\frac{1}{5} & -\frac{6}{5} & -11 \\ 0 & 0 & 1 & -\frac{163}{30} & -\frac{41}{10} & -\frac{161}{3} \\ 0 & 0 & 4 & -\frac{11}{5} & -\frac{41}{5} & -76 \\ 0 & 0 & \frac{52}{5} & -\frac{1}{25} & \frac{29}{25} & -\frac{284}{5} \end{array} \right)$$

5行目を $\frac{293}{5888}$ 倍

$$\left(\begin{array}{ccccc|c} 1 & -\frac{1}{5} & \frac{1}{5} & -\frac{2}{5} & 0 & \frac{2}{5} \\ 0 & 1 & 1 & -\frac{1}{5} & -\frac{6}{5} & -11 \\ 0 & 0 & 1 & -\frac{163}{30} & -\frac{41}{10} & -\frac{161}{3} \\ 0 & 0 & 0 & 1 & \frac{123}{293} & \frac{2080}{293} \\ 0 & 0 & 0 & 0 & 1 & 5 \end{array} \right)$$

4行目に3行目を -4 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & -\frac{1}{5} & \frac{1}{5} & -\frac{2}{5} & 0 & \frac{2}{5} \\ 0 & 1 & 1 & -\frac{1}{5} & -\frac{6}{5} & -11 \\ 0 & 0 & 1 & -\frac{163}{30} & -\frac{41}{10} & -\frac{161}{3} \\ 0 & 0 & 0 & \frac{293}{15} & \frac{41}{5} & \frac{416}{3} \\ 0 & 0 & \frac{52}{5} & -\frac{1}{25} & \frac{29}{25} & -\frac{284}{5} \end{array} \right)$$

4行目に5行目を $-\frac{123}{293}$ 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & -\frac{1}{5} & \frac{1}{5} & -\frac{2}{5} & 0 & \frac{2}{5} \\ 0 & 1 & 1 & -\frac{1}{5} & -\frac{6}{5} & -11 \\ 0 & 0 & 1 & -\frac{163}{30} & -\frac{41}{10} & -\frac{161}{3} \\ 0 & 0 & 0 & 1 & 0 & 5 \\ 0 & 0 & 0 & 0 & 1 & 5 \end{array} \right)$$

5行目に3行目を $-\frac{52}{5}$ 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & -\frac{1}{5} & \frac{1}{5} & -\frac{2}{5} & 0 & \frac{2}{5} \\ 0 & 1 & 1 & -\frac{1}{5} & -\frac{6}{5} & -11 \\ 0 & 0 & 1 & -\frac{163}{30} & -\frac{41}{10} & -\frac{161}{3} \\ 0 & 0 & 0 & \frac{293}{15} & \frac{41}{5} & \frac{416}{3} \\ 0 & 0 & 0 & \frac{847}{15} & \frac{219}{5} & \frac{1504}{3} \end{array} \right)$$

3行目に5行目を $\frac{41}{10}$ 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & -\frac{1}{5} & \frac{1}{5} & -\frac{2}{5} & 0 & \frac{2}{5} \\ 0 & 1 & 1 & -\frac{1}{5} & -\frac{6}{5} & -11 \\ 0 & 0 & 1 & -\frac{163}{30} & 0 & -\frac{199}{6} \\ 0 & 0 & 0 & 1 & 0 & 5 \\ 0 & 0 & 0 & 0 & 1 & 5 \end{array} \right)$$

2行目に5行目を $\frac{6}{5}$ 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & -\frac{1}{5} & \frac{1}{5} & -\frac{2}{5} & 0 & \frac{2}{5} \\ 0 & 1 & 1 & -\frac{1}{5} & 0 & -5 \\ 0 & 0 & 1 & -\frac{163}{30} & 0 & -\frac{199}{6} \\ 0 & 0 & 0 & 1 & 0 & 5 \\ 0 & 0 & 0 & 0 & 1 & 5 \end{array} \right)$$

3行目に4行目を $\frac{163}{30}$ 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & -\frac{1}{5} & \frac{1}{5} & -\frac{2}{5} & 0 & \frac{2}{5} \\ 0 & 1 & 1 & -\frac{1}{5} & 0 & -5 \\ 0 & 0 & 1 & 0 & 0 & -6 \\ 0 & 0 & 0 & 1 & 0 & 5 \\ 0 & 0 & 0 & 0 & 1 & 5 \end{array} \right)$$

2行目に4行目を $\frac{1}{5}$ 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & -\frac{1}{5} & \frac{1}{5} & -\frac{2}{5} & 0 & \frac{2}{5} \\ 0 & 1 & 1 & 0 & 0 & -4 \\ 0 & 0 & 1 & 0 & 0 & -6 \\ 0 & 0 & 0 & 1 & 0 & 5 \\ 0 & 0 & 0 & 0 & 1 & 5 \end{array} \right)$$

1行目に4行目を $\frac{2}{5}$ 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & -\frac{1}{5} & \frac{1}{5} & 0 & 0 & \frac{12}{5} \\ 0 & 1 & 1 & 0 & 0 & -4 \\ 0 & 0 & 1 & 0 & 0 & -6 \\ 0 & 0 & 0 & 1 & 0 & 5 \\ 0 & 0 & 0 & 0 & 1 & 5 \end{array} \right)$$

2行目に3行目を -1 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & -\frac{1}{5} & \frac{1}{5} & 0 & 0 & \frac{12}{5} \\ 0 & 1 & 0 & 0 & 0 & 2 \\ 0 & 0 & 1 & 0 & 0 & -6 \\ 0 & 0 & 0 & 1 & 0 & 5 \\ 0 & 0 & 0 & 0 & 1 & 5 \end{array} \right)$$

1行目に3行目を $-\frac{1}{5}$ 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & -\frac{1}{5} & 0 & 0 & 0 & \frac{18}{5} \\ 0 & 1 & 0 & 0 & 0 & 2 \\ 0 & 0 & 1 & 0 & 0 & -6 \\ 0 & 0 & 0 & 1 & 0 & 5 \\ 0 & 0 & 0 & 0 & 1 & 5 \end{array} \right)$$

1行目に2行目を $\frac{1}{5}$ 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & 0 & 0 & 0 & 0 & 4 \\ 0 & 1 & 0 & 0 & 0 & 2 \\ 0 & 0 & 1 & 0 & 0 & -6 \\ 0 & 0 & 0 & 1 & 0 & 5 \\ 0 & 0 & 0 & 0 & 1 & 5 \end{array} \right)$$

$$\begin{cases} x_1 = 4 \\ x_2 = 2 \\ x_3 = -6 \\ x_4 = 5 \\ x_5 = 5 \end{cases}$$

A.5

$$\begin{cases} -2x_1 + 3x_2 + 3x_3 = 3 \\ 4x_1 - 5x_2 + 6x_3 + 4x_4 = 64 \\ -4x_1 - 4x_2 - 2x_3 + 4x_4 = -2 \\ x_1 + 4x_2 - 3x_3 + 2x_4 = -14 \\ -6x_1 + 8x_2 - 3x_3 - 4x_4 = 6 \end{cases}$$

$$\left(\begin{array}{cccc|c} -2 & 3 & 3 & 0 & 3 \\ 4 & -5 & 6 & 4 & 64 \\ -4 & -4 & -2 & 4 & -2 \\ 1 & 4 & -3 & 2 & -14 \\ -6 & 8 & -3 & -4 & 6 \end{array} \right)$$

1行目を $-\frac{1}{2}$ 倍

$$\left(\begin{array}{cccc|c} 1 & -\frac{3}{2} & -\frac{3}{2} & 0 & -\frac{3}{2} \\ 4 & -5 & 6 & 4 & 64 \\ -4 & -4 & -2 & 4 & -2 \\ 1 & 4 & -3 & 2 & -14 \\ -6 & 8 & -3 & -4 & 6 \end{array} \right)$$

2行目に1行目を -4 倍して、加える

$$\left(\begin{array}{cccc|c} 1 & -\frac{3}{2} & -\frac{3}{2} & 0 & -\frac{3}{2} \\ 0 & 1 & 12 & 4 & 70 \\ -4 & -4 & -2 & 4 & -2 \\ 1 & 4 & -3 & 2 & -14 \\ -6 & 8 & -3 & -4 & 6 \end{array} \right)$$

3行目に1行目を4倍して、加える

$$\left(\begin{array}{cccc|c} 1 & -\frac{3}{2} & -\frac{3}{2} & 0 & -\frac{3}{2} \\ 0 & 1 & 12 & 4 & 70 \\ 0 & -10 & -8 & 4 & -8 \\ 1 & 4 & -3 & 2 & -14 \\ -6 & 8 & -3 & -4 & 6 \end{array} \right)$$

4行目に1行目を -1 倍して、加える

$$\left(\begin{array}{cccc|c} 1 & -\frac{3}{2} & -\frac{3}{2} & 0 & -\frac{3}{2} \\ 0 & 1 & 12 & 4 & 70 \\ 0 & -10 & -8 & 4 & -8 \\ 0 & \frac{11}{2} & -\frac{3}{2} & 2 & -\frac{25}{2} \\ -6 & 8 & -3 & -4 & 6 \end{array} \right)$$

5行目に1行目を6倍して、加える

$$\left(\begin{array}{cccc|c} 1 & -\frac{3}{2} & -\frac{3}{2} & 0 & -\frac{3}{2} \\ 0 & 1 & 12 & 4 & 70 \\ 0 & -10 & -8 & 4 & -8 \\ 0 & \frac{11}{2} & -\frac{3}{2} & 2 & -\frac{25}{2} \\ 0 & -1 & -12 & -4 & -3 \end{array} \right)$$

3行目に2行目を10倍して、加える

$$\left(\begin{array}{cccc|c} 1 & -\frac{3}{2} & -\frac{3}{2} & 0 & -\frac{3}{2} \\ 0 & 1 & 12 & 4 & 70 \\ 0 & 0 & 112 & 44 & 692 \\ 0 & \frac{11}{2} & -\frac{3}{2} & 2 & -\frac{25}{2} \\ 0 & -1 & -12 & -4 & -3 \end{array} \right)$$

4行目に2行目を $-\frac{11}{2}$ 倍して、加える

$$\left(\begin{array}{cccc|c} 1 & -\frac{3}{2} & -\frac{3}{2} & 0 & -\frac{3}{2} \\ 0 & 1 & 12 & 4 & 70 \\ 0 & 0 & 112 & 44 & 692 \\ 0 & 0 & -\frac{135}{2} & -20 & -\frac{795}{2} \\ 0 & -1 & -12 & -4 & -3 \end{array} \right)$$

5行目に2行目を1倍して、加える

$$\left(\begin{array}{cccc|c} 1 & -\frac{3}{2} & -\frac{3}{2} & 0 & -\frac{3}{2} \\ 0 & 1 & 12 & 4 & 70 \\ 0 & 0 & 112 & 44 & 692 \\ 0 & 0 & -\frac{135}{2} & -20 & -\frac{795}{2} \\ 0 & 0 & 0 & 0 & 67 \end{array} \right)$$

3行目を $\frac{1}{112}$ 倍

$$\left(\begin{array}{cccc|c} 1 & -\frac{3}{2} & -\frac{3}{2} & 0 & -\frac{3}{2} \\ 0 & 1 & 12 & 4 & 70 \\ 0 & 0 & 1 & \frac{11}{28} & \frac{173}{28} \\ 0 & 0 & -\frac{135}{2} & -20 & -\frac{795}{2} \\ 0 & 0 & 0 & 0 & 67 \end{array} \right)$$

4行目に3行目を $\frac{135}{2}$ 倍して、加える

$$\left(\begin{array}{cccc|c} 1 & -\frac{3}{2} & -\frac{3}{2} & 0 & -\frac{3}{2} \\ 0 & 1 & 12 & 4 & 70 \\ 0 & 0 & 1 & \frac{11}{28} & \frac{173}{28} \\ 0 & 0 & 0 & \frac{365}{56} & \frac{1095}{56} \\ 0 & 0 & 0 & 0 & 67 \end{array} \right)$$

4行目を $\frac{56}{365}$ 倍

$$\left(\begin{array}{cccc|c} 1 & -\frac{3}{2} & -\frac{3}{2} & 0 & -\frac{3}{2} \\ 0 & 1 & 12 & 4 & 70 \\ 0 & 0 & 1 & \frac{11}{28} & \frac{173}{28} \\ 0 & 0 & 0 & 1 & 3 \\ 0 & 0 & 0 & 0 & 67 \end{array} \right)$$

3行目に4行目を $-\frac{11}{28}$ 倍して、加える

$$\left(\begin{array}{cccc|c} 1 & -\frac{3}{2} & -\frac{3}{2} & 0 & -\frac{3}{2} \\ 0 & 1 & 12 & 4 & 70 \\ 0 & 0 & 1 & 0 & 5 \\ 0 & 0 & 0 & 1 & 3 \\ 0 & 0 & 0 & 0 & 67 \end{array} \right)$$

2行目に4行目を -4 倍して、加える

$$\left(\begin{array}{cccc|c} 1 & -\frac{3}{2} & -\frac{3}{2} & 0 & -\frac{3}{2} \\ 0 & 1 & 12 & 0 & 58 \\ 0 & 0 & 1 & 0 & 5 \\ 0 & 0 & 0 & 1 & 3 \\ 0 & 0 & 0 & 0 & 67 \end{array} \right)$$

2行目に3行目を -12 倍して、加える

$$\left(\begin{array}{cccc|c} 1 & -\frac{3}{2} & -\frac{3}{2} & 0 & -\frac{3}{2} \\ 0 & 1 & 0 & 0 & -2 \\ 0 & 0 & 1 & 0 & 5 \\ 0 & 0 & 0 & 1 & 3 \\ 0 & 0 & 0 & 0 & 67 \end{array} \right)$$

1行目に3行目を $\frac{3}{2}$ 倍して、加える

$$\left(\begin{array}{cccc|c} 1 & -\frac{3}{2} & 0 & 0 & 6 \\ 0 & 1 & 0 & 0 & -2 \\ 0 & 0 & 1 & 0 & 5 \\ 0 & 0 & 0 & 1 & 3 \\ 0 & 0 & 0 & 0 & 67 \end{array} \right)$$

1行目に2行目を $\frac{3}{2}$ 倍して、加える

$$\left(\begin{array}{cccc|c} 1 & 0 & 0 & 0 & 3 \\ 0 & 1 & 0 & 0 & -2 \\ 0 & 0 & 1 & 0 & 5 \\ 0 & 0 & 0 & 1 & 3 \\ 0 & 0 & 0 & 0 & 67 \end{array} \right)$$

解なし

A.6

$$\begin{cases} -2x_1 + 4x_2 - 4x_3 = 2 \\ -x_1 - 6x_2 + x_3 = 24 \\ x_1 + 3x_2 + 5x_3 = -30 \end{cases}$$

$$\left(\begin{array}{ccc|c} -2 & 4 & -4 & 2 \\ -1 & -6 & 1 & 24 \\ 1 & 3 & 5 & -30 \end{array} \right)$$

1行目を $-\frac{1}{2}$ 倍

$$\left(\begin{array}{ccc|c} 1 & -2 & 2 & -1 \\ -1 & -6 & 1 & 24 \\ 1 & 3 & 5 & -30 \end{array} \right)$$

2行目に1行目を1倍して、加える

$$\left(\begin{array}{ccc|c} 1 & -2 & 2 & -1 \\ 0 & -8 & 3 & 23 \\ 1 & 3 & 5 & -30 \end{array} \right)$$

3行目に1行目を -1 倍して、加える

$$\left(\begin{array}{ccc|c} 1 & -2 & 2 & -1 \\ 0 & -8 & 3 & 23 \\ 0 & 5 & 3 & -29 \end{array} \right)$$

2行目を $-\frac{1}{8}$ 倍

$$\left(\begin{array}{ccc|c} 1 & -2 & 2 & -1 \\ 0 & 1 & -\frac{3}{8} & -\frac{23}{8} \\ 0 & 5 & 3 & -29 \end{array} \right)$$

3行目に2行目を -5 倍して、加える

$$\left(\begin{array}{ccc|c} 1 & -2 & 2 & -1 \\ 0 & 1 & -\frac{3}{8} & -\frac{23}{8} \\ 0 & 0 & \frac{39}{8} & -\frac{117}{8} \end{array} \right)$$

3行目を $\frac{8}{39}$ 倍

$$\left(\begin{array}{ccc|c} 1 & -2 & 2 & -1 \\ 0 & 1 & -\frac{3}{8} & -\frac{23}{8} \\ 0 & 0 & 1 & -3 \end{array} \right)$$

2行目に3行目を $\frac{3}{8}$ 倍して、加える

$$\left(\begin{array}{ccc|c} 1 & -2 & 2 & -1 \\ 0 & 1 & 0 & -4 \\ 0 & 0 & 1 & -3 \end{array} \right)$$

1行目に3行目を -2 倍して、加える

$$\left(\begin{array}{ccc|c} 1 & -2 & 0 & 5 \\ 0 & 1 & 0 & -4 \\ 0 & 0 & 1 & -3 \end{array} \right)$$

1行目に2行目を2倍して、加える

$$\left(\begin{array}{ccc|c} 1 & 0 & 0 & -3 \\ 0 & 1 & 0 & -4 \\ 0 & 0 & 1 & -3 \end{array} \right)$$

$$\begin{cases} x_1 = -3 \\ x_2 = -4 \\ x_3 = -3 \end{cases}$$

3行目に1行目を-2倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & 0 & \frac{3}{2} & \frac{3}{2} & -\frac{5}{2} & 3 \\ 0 & 0 & \frac{15}{2} & \frac{13}{2} & -\frac{25}{2} & 6 \\ 0 & 0 & -6 & -1 & 1 & 24 \\ -4 & 0 & 3 & -6 & -1 & 18 \\ 0 & 0 & -5 & -5 & 0 & 50 \end{array} \right)$$

4行目に1行目を4倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & 0 & \frac{3}{2} & \frac{3}{2} & -\frac{5}{2} & 3 \\ 0 & 0 & \frac{15}{2} & \frac{13}{2} & -\frac{25}{2} & 6 \\ 0 & 0 & -6 & -1 & 1 & 24 \\ 0 & 0 & 9 & 0 & -11 & 30 \\ 0 & 0 & -5 & -5 & 0 & 50 \end{array} \right)$$

2列目と3列目を交換

$$\left(\begin{array}{ccccc|c} 1 & \frac{3}{2} & 0 & \frac{3}{2} & -\frac{5}{2} & 3 \\ 0 & \frac{15}{2} & 0 & \frac{13}{2} & -\frac{25}{2} & 6 \\ 0 & -6 & 0 & -1 & 1 & 24 \\ 0 & 9 & 0 & 0 & -11 & 30 \\ 0 & -5 & 0 & -5 & 0 & 50 \end{array} \right)$$

2行目を $\frac{2}{15}$ 倍

$$\left(\begin{array}{ccccc|c} 1 & \frac{3}{2} & 0 & \frac{3}{2} & -\frac{5}{2} & 3 \\ 0 & 1 & 0 & \frac{13}{15} & -\frac{5}{3} & \frac{4}{5} \\ 0 & -6 & 0 & -1 & 1 & 24 \\ 0 & 9 & 0 & 0 & -11 & 30 \\ 0 & -5 & 0 & -5 & 0 & 50 \end{array} \right)$$

3行目に2行目を6倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & \frac{3}{2} & 0 & \frac{3}{2} & -\frac{5}{2} & 3 \\ 0 & 1 & 0 & \frac{13}{15} & -\frac{5}{3} & \frac{4}{5} \\ 0 & 0 & 0 & \frac{21}{5} & -9 & \frac{144}{5} \\ 0 & 9 & 0 & 0 & -11 & 30 \\ 0 & -5 & 0 & -5 & 0 & 50 \end{array} \right)$$

4行目に2行目を-9倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & \frac{3}{2} & 0 & \frac{3}{2} & -\frac{5}{2} & 3 \\ 0 & 1 & 0 & \frac{13}{15} & -\frac{5}{3} & \frac{4}{5} \\ 0 & 0 & 0 & \frac{21}{5} & -9 & \frac{144}{5} \\ 0 & 0 & 0 & -\frac{39}{5} & 4 & \frac{114}{5} \\ 0 & -5 & 0 & -5 & 0 & 50 \end{array} \right)$$

A.7

$$\begin{cases} -2x_1 & -3x_3 & -3x_4 & +5x_5 & = & -6 \\ -5x_1 & & & -x_4 & = & -9 \\ 2x_1 & -3x_3 & +2x_4 & -4x_5 & = & 30 \\ -4x_1 & +3x_3 & -6x_4 & -x_5 & = & 18 \\ & -5x_3 & -5x_4 & & = & 50 \end{cases}$$

$$\left(\begin{array}{ccccc|c} -2 & 0 & -3 & -3 & 5 & -6 \\ -5 & 0 & 0 & -1 & 0 & -9 \\ 2 & 0 & -3 & 2 & -4 & 30 \\ -4 & 0 & 3 & -6 & -1 & 18 \\ 0 & 0 & -5 & -5 & 0 & 50 \end{array} \right)$$

1行目を $-\frac{1}{2}$ 倍

$$\left(\begin{array}{ccccc|c} 1 & 0 & \frac{3}{2} & \frac{3}{2} & -\frac{5}{2} & 3 \\ -5 & 0 & 0 & -1 & 0 & -9 \\ 2 & 0 & -3 & 2 & -4 & 30 \\ -4 & 0 & 3 & -6 & -1 & 18 \\ 0 & 0 & -5 & -5 & 0 & 50 \end{array} \right)$$

2行目に1行目を5倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & 0 & \frac{3}{2} & \frac{3}{2} & -\frac{5}{2} & 3 \\ 0 & 0 & \frac{15}{2} & \frac{13}{2} & -\frac{25}{2} & 6 \\ 2 & 0 & -3 & 2 & -4 & 30 \\ -4 & 0 & 3 & -6 & -1 & 18 \\ 0 & 0 & -5 & -5 & 0 & 50 \end{array} \right)$$

5行目に2行目を5倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & \frac{3}{2} & 0 & \frac{3}{2} & -\frac{5}{2} & 3 \\ 0 & 1 & 0 & \frac{13}{15} & -\frac{5}{3} & \frac{4}{5} \\ 0 & 0 & 0 & \frac{21}{5} & -9 & \frac{144}{5} \\ 0 & 0 & 0 & -\frac{39}{5} & 4 & \frac{114}{5} \\ 0 & 0 & 0 & -\frac{2}{3} & -\frac{25}{3} & 54 \end{array} \right)$$

4列目と5列目を交換

$$\left(\begin{array}{ccccc|c} 1 & \frac{3}{2} & \frac{3}{2} & -\frac{5}{2} & 0 & 3 \\ 0 & 1 & \frac{13}{15} & -\frac{5}{3} & 0 & \frac{4}{5} \\ 0 & 0 & 1 & -\frac{15}{7} & 0 & \frac{48}{7} \\ 0 & 0 & 0 & -\frac{89}{7} & 0 & \frac{534}{7} \\ 0 & 0 & 0 & -\frac{205}{21} & 0 & \frac{410}{7} \end{array} \right)$$

3列目と4列目を交換

$$\left(\begin{array}{ccccc|c} 1 & \frac{3}{2} & \frac{3}{2} & 0 & -\frac{5}{2} & 3 \\ 0 & 1 & \frac{13}{15} & 0 & -\frac{5}{3} & \frac{4}{5} \\ 0 & 0 & \frac{21}{5} & 0 & -9 & \frac{144}{5} \\ 0 & 0 & -\frac{39}{5} & 0 & 4 & \frac{114}{5} \\ 0 & 0 & -\frac{2}{3} & 0 & -\frac{25}{3} & 54 \end{array} \right)$$

4行目を $-\frac{7}{89}$ 倍

$$\left(\begin{array}{ccccc|c} 1 & \frac{3}{2} & \frac{3}{2} & -\frac{5}{2} & 0 & 3 \\ 0 & 1 & \frac{13}{15} & -\frac{5}{3} & 0 & \frac{4}{5} \\ 0 & 0 & 1 & -\frac{15}{7} & 0 & \frac{48}{7} \\ 0 & 0 & 0 & 1 & 0 & -6 \\ 0 & 0 & 0 & -\frac{205}{21} & 0 & \frac{410}{7} \end{array} \right)$$

3行目を $\frac{5}{21}$ 倍

$$\left(\begin{array}{ccccc|c} 1 & \frac{3}{2} & \frac{3}{2} & 0 & -\frac{5}{2} & 3 \\ 0 & 1 & \frac{13}{15} & 0 & -\frac{5}{3} & \frac{4}{5} \\ 0 & 0 & 1 & 0 & -\frac{15}{7} & \frac{48}{7} \\ 0 & 0 & -\frac{39}{5} & 0 & 4 & \frac{114}{5} \\ 0 & 0 & -\frac{2}{3} & 0 & -\frac{25}{3} & 54 \end{array} \right)$$

5行目に4行目を $\frac{205}{21}$ 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & \frac{3}{2} & \frac{3}{2} & -\frac{5}{2} & 0 & 3 \\ 0 & 1 & \frac{13}{15} & -\frac{5}{3} & 0 & \frac{4}{5} \\ 0 & 0 & 1 & -\frac{15}{7} & 0 & \frac{48}{7} \\ 0 & 0 & 0 & 1 & 0 & -6 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{array} \right)$$

4行目に3行目を $\frac{39}{5}$ 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & \frac{3}{2} & \frac{3}{2} & 0 & -\frac{5}{2} & 3 \\ 0 & 1 & \frac{13}{15} & 0 & -\frac{5}{3} & \frac{4}{5} \\ 0 & 0 & 1 & 0 & -\frac{15}{7} & \frac{48}{7} \\ 0 & 0 & 0 & 0 & -\frac{89}{7} & \frac{534}{7} \\ 0 & 0 & -\frac{2}{3} & 0 & -\frac{25}{3} & 54 \end{array} \right)$$

3行目に4行目を $\frac{15}{7}$ 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & \frac{3}{2} & \frac{3}{2} & -\frac{5}{2} & 0 & 3 \\ 0 & 1 & \frac{13}{15} & -\frac{5}{3} & 0 & \frac{4}{5} \\ 0 & 0 & 1 & 0 & 0 & -6 \\ 0 & 0 & 0 & 1 & 0 & -6 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{array} \right)$$

5行目に3行目を $\frac{2}{3}$ 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & \frac{3}{2} & \frac{3}{2} & 0 & -\frac{5}{2} & 3 \\ 0 & 1 & \frac{13}{15} & 0 & -\frac{5}{3} & \frac{4}{5} \\ 0 & 0 & 1 & 0 & -\frac{15}{7} & \frac{48}{7} \\ 0 & 0 & 0 & 0 & -\frac{89}{7} & \frac{534}{7} \\ 0 & 0 & 0 & 0 & -\frac{205}{21} & \frac{410}{7} \end{array} \right)$$

2行目に4行目を $\frac{5}{3}$ 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & \frac{3}{2} & \frac{3}{2} & -\frac{5}{2} & 0 & 3 \\ 0 & 1 & \frac{13}{15} & 0 & 0 & -\frac{46}{5} \\ 0 & 0 & 1 & 0 & 0 & -6 \\ 0 & 0 & 0 & 1 & 0 & -6 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{array} \right)$$

1行目に4行目を $\frac{5}{2}$ 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & \frac{3}{2} & \frac{3}{2} & 0 & 0 & -12 \\ 0 & 1 & \frac{13}{15} & 0 & 0 & -\frac{46}{5} \\ 0 & 0 & 1 & 0 & 0 & -6 \\ 0 & 0 & 0 & 1 & 0 & -6 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{array} \right)$$

$$\left(\begin{array}{ccc|c} -6 & -6 & -6 & -48 \\ 1 & 1 & 2 & 8 \\ -5 & 5 & -2 & -20 \\ -7 & -7 & -8 & -56 \end{array} \right)$$

1行目を $-\frac{1}{6}$ 倍

2行目に3行目を $-\frac{13}{15}$ 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & \frac{3}{2} & \frac{3}{2} & 0 & 0 & -12 \\ 0 & 1 & 0 & 0 & 0 & -4 \\ 0 & 0 & 1 & 0 & 0 & -6 \\ 0 & 0 & 0 & 1 & 0 & -6 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{array} \right)$$

$$\left(\begin{array}{ccc|c} 1 & 1 & 1 & 8 \\ 1 & 1 & 2 & 8 \\ -5 & 5 & -2 & -20 \\ -7 & -7 & -8 & -56 \end{array} \right)$$

2行目に1行目を -1 倍して、加える

1行目に3行目を $-\frac{3}{2}$ 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & \frac{3}{2} & 0 & 0 & 0 & -3 \\ 0 & 1 & 0 & 0 & 0 & -4 \\ 0 & 0 & 1 & 0 & 0 & -6 \\ 0 & 0 & 0 & 1 & 0 & -6 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{array} \right)$$

$$\left(\begin{array}{ccc|c} 1 & 1 & 1 & 8 \\ 0 & 0 & 1 & 0 \\ -5 & 5 & -2 & -20 \\ -7 & -7 & -8 & -56 \end{array} \right)$$

3行目に1行目を5倍して、加える

1行目に2行目を $-\frac{3}{2}$ 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & 0 & 0 & 0 & 0 & 3 \\ 0 & 1 & 0 & 0 & 0 & -4 \\ 0 & 0 & 1 & 0 & 0 & -6 \\ 0 & 0 & 0 & 1 & 0 & -6 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{array} \right)$$

$$\left(\begin{array}{ccc|c} 1 & 1 & 1 & 8 \\ 0 & 0 & 1 & 0 \\ 0 & 10 & 3 & 20 \\ -7 & -7 & -8 & -56 \end{array} \right)$$

4行目に1行目を7倍して、加える

$$\begin{cases} x_1 = & 3 \\ x_3 = & -4 \\ x_4 = & -6 \\ x_5 = & -6 \\ x_2 = & p_2 \end{cases}$$

$$\left(\begin{array}{ccc|c} 1 & 1 & 1 & 8 \\ 0 & 0 & 1 & 0 \\ 0 & 10 & 3 & 20 \\ 0 & 0 & -1 & 0 \end{array} \right)$$

2行目と3行目を交換

A.8

$$\begin{cases} -6x_1 - 6x_2 - 6x_3 = -48 \\ x_1 + x_2 + 2x_3 = 8 \\ -5x_1 + 5x_2 - 2x_3 = -20 \\ -7x_1 - 7x_2 - 8x_3 = -56 \end{cases}$$

$$\left(\begin{array}{ccc|c} 1 & 1 & 1 & 8 \\ 0 & 10 & 3 & 20 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & -1 & 0 \end{array} \right)$$

2行目を $\frac{1}{10}$ 倍

$$\left(\begin{array}{ccc|c} 1 & 1 & 1 & 8 \\ 0 & 1 & \frac{3}{10} & 2 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & -1 & 0 \end{array} \right)$$

4行目に3行目を1倍して、加える

$$\left(\begin{array}{ccc|c} 1 & 1 & 1 & 8 \\ 0 & 1 & \frac{3}{10} & 2 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 \end{array} \right)$$

2行目に3行目を $-\frac{3}{10}$ 倍して、加える

$$\left(\begin{array}{ccc|c} 1 & 1 & 1 & 8 \\ 0 & 1 & 0 & 2 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 \end{array} \right)$$

1行目に3行目を -1 倍して、加える

$$\left(\begin{array}{ccc|c} 1 & 1 & 0 & 8 \\ 0 & 1 & 0 & 2 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 \end{array} \right)$$

1行目に2行目を -1 倍して、加える

$$\left(\begin{array}{ccc|c} 1 & 0 & 0 & 6 \\ 0 & 1 & 0 & 2 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 \end{array} \right)$$

$$\begin{cases} x_1 = 6 \\ x_2 = 2 \\ x_3 = 0 \end{cases}$$

A.9

$$\begin{cases} -6x_2 + 3x_3 - 6x_4 = 72 \\ 4x_2 - 3x_3 + 4x_4 = -50 \\ -4x_2 + 2x_3 + 5x_4 = -6 \\ -x_2 - 6x_3 + x_4 = -13 \end{cases}$$

$$\left(\begin{array}{cccc|c} 0 & -6 & 3 & -6 & 72 \\ 0 & 4 & -3 & 4 & -50 \\ 0 & -4 & 2 & 5 & -6 \\ 0 & -1 & -6 & 1 & -13 \end{array} \right)$$

1列目と2列目を交換

$$\left(\begin{array}{cccc|c} -6 & 0 & 3 & -6 & 72 \\ 4 & 0 & -3 & 4 & -50 \\ -4 & 0 & 2 & 5 & -6 \\ -1 & 0 & -6 & 1 & -13 \end{array} \right)$$

1行目を $-\frac{1}{6}$ 倍

$$\left(\begin{array}{cccc|c} 1 & 0 & -\frac{1}{2} & 1 & -12 \\ 4 & 0 & -3 & 4 & -50 \\ -4 & 0 & 2 & 5 & -6 \\ -1 & 0 & -6 & 1 & -13 \end{array} \right)$$

2行目に1行目を -4 倍して、加える

$$\left(\begin{array}{cccc|c} 1 & 0 & -\frac{1}{2} & 1 & -12 \\ 0 & 0 & -1 & 0 & -2 \\ -4 & 0 & 2 & 5 & -6 \\ -1 & 0 & -6 & 1 & -13 \end{array} \right)$$

3行目に1行目を4倍して、加える

$$\left(\begin{array}{cccc|c} 1 & 0 & -\frac{1}{2} & 1 & -12 \\ 0 & 0 & -1 & 0 & -2 \\ 0 & 0 & 0 & 9 & -54 \\ -1 & 0 & -6 & 1 & -13 \end{array} \right)$$

4行目に1行目を1倍して、加える

$$\left(\begin{array}{cccc|c} 1 & 0 & -\frac{1}{2} & 1 & -12 \\ 0 & 0 & -1 & 0 & -2 \\ 0 & 0 & 0 & 9 & -54 \\ 0 & 0 & -\frac{13}{2} & 2 & -25 \end{array} \right)$$

2列目と3列目を交換

$$\left(\begin{array}{cccc|c} 1 & -\frac{1}{2} & 0 & 1 & -12 \\ 0 & -1 & 0 & 0 & -2 \\ 0 & 0 & 0 & 9 & -54 \\ 0 & -\frac{13}{2} & 0 & 2 & -25 \end{array} \right)$$

2行目を -1 倍

$$\left(\begin{array}{cccc|c} 1 & -\frac{1}{2} & 0 & 1 & -12 \\ 0 & 1 & 0 & 0 & 2 \\ 0 & 0 & 0 & 9 & -54 \\ 0 & -\frac{13}{2} & 0 & 2 & -25 \end{array} \right)$$

1行目に2行目を $\frac{1}{2}$ 倍して、加える

$$\left(\begin{array}{cccc|c} 1 & 0 & 0 & 0 & -5 \\ 0 & 1 & 0 & 0 & 2 \\ 0 & 0 & 1 & 0 & -6 \\ 0 & 0 & 0 & 0 & 0 \end{array} \right)$$

4行目に2行目を $\frac{13}{2}$ 倍して、加える

$$\left(\begin{array}{cccc|c} 1 & -\frac{1}{2} & 0 & 1 & -12 \\ 0 & 1 & 0 & 0 & 2 \\ 0 & 0 & 0 & 9 & -54 \\ 0 & 0 & 0 & 2 & -12 \end{array} \right)$$

$$\begin{cases} x_2 = & -5 \\ x_3 = & 2 \\ x_4 = & -6 \\ x_1 = & p_1 \end{cases}$$

3列目と4列目を交換

$$\left(\begin{array}{cccc|c} 1 & -\frac{1}{2} & 1 & 0 & -12 \\ 0 & 1 & 0 & 0 & 2 \\ 0 & 0 & 9 & 0 & -54 \\ 0 & 0 & 2 & 0 & -12 \end{array} \right)$$

A.10

$$\begin{cases} 5x_1 + 10x_2 + 4x_3 - 5x_4 - 2x_5 = -2 \\ 2x_1 + 4x_2 + 5x_3 - 5x_4 + x_5 = -1 \\ 3x_1 + 6x_2 - x_3 + 4x_4 = \\ -3x_1 - 6x_2 + 4x_3 - 5x_4 = -2 \\ 2x_1 + 4x_2 + 2x_3 + 5x_4 + x_5 = -1 \\ -5x_1 - 10x_2 - x_3 - x_5 = \end{cases}$$

3行目を $\frac{1}{9}$ 倍

$$\left(\begin{array}{cccc|c} 1 & -\frac{1}{2} & 1 & 0 & -12 \\ 0 & 1 & 0 & 0 & 2 \\ 0 & 0 & 1 & 0 & -6 \\ 0 & 0 & 2 & 0 & -12 \end{array} \right)$$

$$\left(\begin{array}{ccccc|c} 5 & 10 & 4 & -5 & -2 & -22 \\ 2 & 4 & 5 & -5 & 1 & -19 \\ 3 & 6 & -1 & 4 & 0 & 5 \\ -3 & -6 & 4 & -5 & 0 & -22 \\ 2 & 4 & 2 & 5 & 1 & -11 \\ -5 & -10 & -1 & 0 & -1 & -3 \end{array} \right)$$

4行目に3行目を -2 倍して、加える

$$\left(\begin{array}{cccc|c} 1 & -\frac{1}{2} & 1 & 0 & -12 \\ 0 & 1 & 0 & 0 & 2 \\ 0 & 0 & 1 & 0 & -6 \\ 0 & 0 & 0 & 0 & 0 \end{array} \right)$$

1行目を $\frac{1}{5}$ 倍

$$\left(\begin{array}{ccccc|c} 1 & 2 & \frac{4}{5} & -1 & -\frac{2}{5} & -\frac{22}{5} \\ 2 & 4 & 5 & -5 & 1 & -19 \\ 3 & 6 & -1 & 4 & 0 & 5 \\ -3 & -6 & 4 & -5 & 0 & -22 \\ 2 & 4 & 2 & 5 & 1 & -11 \\ -5 & -10 & -1 & 0 & -1 & -3 \end{array} \right)$$

1行目に3行目を -1 倍して、加える

$$\left(\begin{array}{cccc|c} 1 & -\frac{1}{2} & 0 & 0 & -6 \\ 0 & 1 & 0 & 0 & 2 \\ 0 & 0 & 1 & 0 & -6 \\ 0 & 0 & 0 & 0 & 0 \end{array} \right)$$

2行目に1行目を -2 倍して、加える

$$\left(\begin{array}{cccc|c} 1 & 2 & \frac{4}{5} & -1 & -\frac{2}{5} & -\frac{22}{5} \\ 0 & 0 & \frac{17}{5} & -3 & \frac{9}{5} & -\frac{51}{5} \\ 3 & 6 & -1 & 4 & 0 & 5 \\ -3 & -6 & 4 & -5 & 0 & -22 \\ 2 & 4 & 2 & 5 & 1 & -11 \\ -5 & -10 & -1 & 0 & -1 & -3 \end{array} \right)$$

2列目と3列目を交換

$$\left(\begin{array}{ccc|cc} 1 & \frac{4}{5} & 2 & -1 & -\frac{2}{5} & -\frac{22}{5} \\ 0 & \frac{17}{5} & 0 & -3 & \frac{9}{5} & -\frac{51}{5} \\ 0 & -\frac{17}{5} & 0 & 7 & \frac{6}{5} & \frac{91}{5} \\ 0 & \frac{32}{5} & 0 & -8 & -\frac{6}{5} & -\frac{176}{5} \\ 0 & \frac{2}{5} & 0 & 7 & \frac{9}{5} & -\frac{11}{5} \\ 0 & 3 & 0 & -5 & -3 & -25 \end{array} \right)$$

3行目に1行目を -3 倍して、加える

$$\left(\begin{array}{cccc|c} 1 & 2 & \frac{4}{5} & -1 & -\frac{2}{5} & -\frac{22}{5} \\ 0 & 0 & \frac{17}{5} & -3 & \frac{9}{5} & -\frac{51}{5} \\ 0 & 0 & -\frac{17}{5} & 7 & \frac{6}{5} & \frac{91}{5} \\ -3 & -6 & 4 & -5 & 0 & -22 \\ 2 & 4 & 2 & 5 & 1 & -11 \\ -5 & -10 & -1 & 0 & -1 & -3 \end{array} \right)$$

2行目を $\frac{5}{17}$ 倍

$$\left(\begin{array}{cccc|c} 1 & \frac{4}{5} & 2 & -1 & -\frac{2}{5} & -\frac{22}{5} \\ 0 & 1 & 0 & -\frac{15}{17} & \frac{9}{17} & -3 \\ 0 & -\frac{17}{5} & 0 & 7 & \frac{6}{5} & \frac{91}{5} \\ 0 & \frac{32}{5} & 0 & -8 & -\frac{6}{5} & -\frac{176}{5} \\ 0 & \frac{2}{5} & 0 & 7 & \frac{9}{5} & -\frac{11}{5} \\ 0 & 3 & 0 & -5 & -3 & -25 \end{array} \right)$$

4行目に1行目を3倍して、加える

$$\left(\begin{array}{cccc|c} 1 & 2 & \frac{4}{5} & -1 & -\frac{2}{5} & -\frac{22}{5} \\ 0 & 0 & \frac{17}{5} & -3 & \frac{9}{5} & -\frac{51}{5} \\ 0 & 0 & -\frac{17}{5} & 7 & \frac{6}{5} & \frac{91}{5} \\ 0 & 0 & \frac{32}{5} & -8 & -\frac{6}{5} & -\frac{176}{5} \\ 2 & 4 & 2 & 5 & 1 & -11 \\ -5 & -10 & -1 & 0 & -1 & -3 \end{array} \right)$$

3行目に2行目を $\frac{17}{5}$ 倍して、加える

$$\left(\begin{array}{ccc|cc} 1 & \frac{4}{5} & 2 & -1 & -\frac{2}{5} & -\frac{22}{5} \\ 0 & 1 & 0 & -\frac{15}{17} & \frac{9}{17} & -3 \\ 0 & 0 & 0 & 4 & 3 & 8 \\ 0 & \frac{32}{5} & 0 & -8 & -\frac{6}{5} & -\frac{176}{5} \\ 0 & \frac{2}{5} & 0 & 7 & \frac{9}{5} & -\frac{11}{5} \\ 0 & 3 & 0 & -5 & -3 & -25 \end{array} \right)$$

5行目に1行目を -2 倍して、加える

$$\left(\begin{array}{cccc|c} 1 & 2 & \frac{4}{5} & -1 & -\frac{2}{5} & -\frac{22}{5} \\ 0 & 0 & \frac{17}{5} & -3 & \frac{9}{5} & -\frac{51}{5} \\ 0 & 0 & -\frac{17}{5} & 7 & \frac{6}{5} & \frac{91}{5} \\ 0 & 0 & \frac{32}{5} & -8 & -\frac{6}{5} & -\frac{176}{5} \\ 0 & 0 & \frac{2}{5} & 7 & \frac{9}{5} & -\frac{11}{5} \\ -5 & -10 & -1 & 0 & -1 & -3 \end{array} \right)$$

4行目に2行目を $-\frac{32}{5}$ 倍して、加える

$$\left(\begin{array}{ccc|cc} 1 & \frac{4}{5} & 2 & -1 & -\frac{2}{5} & -\frac{22}{5} \\ 0 & 1 & 0 & -\frac{15}{17} & \frac{9}{17} & -3 \\ 0 & 0 & 0 & 4 & 3 & 8 \\ 0 & 0 & 0 & -\frac{40}{17} & -\frac{78}{17} & -16 \\ 0 & \frac{2}{5} & 0 & 7 & \frac{9}{5} & -\frac{11}{5} \\ 0 & 3 & 0 & -5 & -3 & -25 \end{array} \right)$$

6行目に1行目を5倍して、加える

$$\left(\begin{array}{cccc|c} 1 & 2 & \frac{4}{5} & -1 & -\frac{2}{5} & -\frac{22}{5} \\ 0 & 0 & \frac{17}{5} & -3 & \frac{9}{5} & -\frac{51}{5} \\ 0 & 0 & -\frac{17}{5} & 7 & \frac{6}{5} & \frac{91}{5} \\ 0 & 0 & \frac{32}{5} & -8 & -\frac{6}{5} & -\frac{176}{5} \\ 0 & 0 & \frac{2}{5} & 7 & \frac{9}{5} & -\frac{11}{5} \\ 0 & 0 & 3 & -5 & -3 & -25 \end{array} \right)$$

5行目に2行目を $-\frac{2}{5}$ 倍して、加える

$$\left(\begin{array}{ccc|cc} 1 & \frac{4}{5} & 2 & -1 & -\frac{2}{5} & -\frac{22}{5} \\ 0 & 1 & 0 & -\frac{15}{17} & \frac{9}{17} & -3 \\ 0 & 0 & 0 & 4 & 3 & 8 \\ 0 & 0 & 0 & -\frac{40}{17} & -\frac{78}{17} & -16 \\ 0 & 0 & 0 & \frac{125}{17} & \frac{27}{17} & -1 \\ 0 & 3 & 0 & -5 & -3 & -25 \end{array} \right)$$

3行目に4行目を $-\frac{3}{4}$ 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & \frac{4}{5} & -1 & -\frac{2}{5} & 2 & -\frac{22}{5} \\ 0 & 1 & -\frac{15}{17} & \frac{9}{17} & 0 & -3 \\ 0 & 0 & 1 & 0 & 0 & -1 \\ 0 & 0 & 0 & 1 & 0 & 4 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{array} \right)$$

2行目に4行目を $-\frac{9}{17}$ 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & \frac{4}{5} & -1 & -\frac{2}{5} & 2 & -\frac{22}{5} \\ 0 & 1 & -\frac{15}{17} & 0 & 0 & -\frac{87}{17} \\ 0 & 0 & 1 & 0 & 0 & -1 \\ 0 & 0 & 0 & 1 & 0 & 4 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{array} \right)$$

1行目に4行目を $\frac{2}{5}$ 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & \frac{4}{5} & -1 & 0 & 2 & -\frac{14}{5} \\ 0 & 1 & -\frac{15}{17} & 0 & 0 & -\frac{87}{17} \\ 0 & 0 & 1 & 0 & 0 & -1 \\ 0 & 0 & 0 & 1 & 0 & 4 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{array} \right)$$

2行目に3行目を $\frac{15}{17}$ 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & \frac{4}{5} & -1 & 0 & 2 & -\frac{14}{5} \\ 0 & 1 & 0 & 0 & 0 & -6 \\ 0 & 0 & 1 & 0 & 0 & -1 \\ 0 & 0 & 0 & 1 & 0 & 4 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{array} \right)$$

1行目に3行目を1倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & \frac{4}{5} & 0 & 0 & 2 & -\frac{19}{5} \\ 0 & 1 & 0 & 0 & 0 & -6 \\ 0 & 0 & 1 & 0 & 0 & -1 \\ 0 & 0 & 0 & 1 & 0 & 4 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{array} \right)$$

1行目に2行目を $-\frac{4}{5}$ 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & 0 & 0 & 0 & 2 & 1 \\ 0 & 1 & 0 & 0 & 0 & -6 \\ 0 & 0 & 1 & 0 & 0 & -1 \\ 0 & 0 & 0 & 1 & 0 & 4 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{array} \right)$$

$$\begin{cases} x_1 = -2p_2 + 1 \\ x_3 = -6 \\ x_4 = -1 \\ x_5 = 4 \\ x_2 = p_2 \end{cases}$$

A.11

$$\begin{cases} -x_1 + 4x_3 + 4x_4 + 5x_5 = -23 \\ 6x_1 + 5x_2 + 3x_3 - 6x_4 + 6x_5 = -30 \\ 2x_1 - 4x_2 + 4x_3 + 3x_4 + 5x_5 = -62 \\ 5x_1 + 2x_3 + 6x_4 - x_5 = -25 \end{cases}$$

$$\left(\begin{array}{ccccc|c} -1 & 0 & 4 & 4 & 5 & -23 \\ 6 & 5 & 3 & -6 & 6 & -30 \\ 2 & -4 & 4 & 3 & 5 & -62 \\ 5 & 0 & 2 & 6 & -1 & -25 \end{array} \right)$$

1行目を -1 倍

$$\left(\begin{array}{ccccc|c} 1 & 0 & -4 & -4 & -5 & 23 \\ 6 & 5 & 3 & -6 & 6 & -30 \\ 2 & -4 & 4 & 3 & 5 & -62 \\ 5 & 0 & 2 & 6 & -1 & -25 \end{array} \right)$$

2行目に1行目を -6 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & 0 & -4 & -4 & -5 & 23 \\ 0 & 5 & 27 & 18 & 36 & -168 \\ 2 & -4 & 4 & 3 & 5 & -62 \\ 5 & 0 & 2 & 6 & -1 & -25 \end{array} \right)$$

3行目に1行目を -2 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & 0 & -4 & -4 & -5 & 23 \\ 0 & 5 & 27 & 18 & 36 & -168 \\ 0 & -4 & 12 & 11 & 15 & -108 \\ 5 & 0 & 2 & 6 & -1 & -25 \end{array} \right)$$

4行目に1行目を -5 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & 0 & -4 & -4 & -5 & 23 \\ 0 & 5 & 27 & 18 & 36 & -168 \\ 0 & -4 & 12 & 11 & 15 & -108 \\ 0 & 0 & 22 & 26 & 24 & -140 \end{array} \right)$$

2行目を $\frac{1}{5}$ 倍

$$\left(\begin{array}{ccccc|c} 1 & 0 & -4 & -4 & -5 & 23 \\ 0 & 1 & \frac{27}{5} & \frac{18}{5} & \frac{36}{5} & -\frac{168}{5} \\ 0 & -4 & 12 & 11 & 15 & -108 \\ 0 & 0 & 22 & 26 & 24 & -140 \end{array} \right)$$

3行目に2行目を4倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & 0 & -4 & -4 & -5 & 23 \\ 0 & 1 & \frac{27}{5} & \frac{18}{5} & \frac{36}{5} & -\frac{168}{5} \\ 0 & 0 & \frac{168}{5} & \frac{127}{5} & \frac{219}{5} & -\frac{1212}{5} \\ 0 & 0 & 22 & 26 & 24 & -140 \end{array} \right)$$

3行目を $\frac{5}{168}$ 倍

$$\left(\begin{array}{ccccc|c} 1 & 0 & -4 & -4 & -5 & 23 \\ 0 & 1 & \frac{27}{5} & \frac{18}{5} & \frac{36}{5} & -\frac{168}{5} \\ 0 & 0 & 1 & \frac{127}{168} & \frac{73}{56} & -\frac{101}{14} \\ 0 & 0 & 22 & 26 & 24 & -140 \end{array} \right)$$

4行目に3行目を -22 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & 0 & -4 & -4 & -5 & 23 \\ 0 & 1 & \frac{27}{5} & \frac{18}{5} & \frac{36}{5} & -\frac{168}{5} \\ 0 & 0 & 1 & \frac{127}{168} & \frac{73}{56} & -\frac{101}{14} \\ 0 & 0 & 0 & \frac{787}{84} & -\frac{131}{28} & \frac{131}{7} \end{array} \right)$$

4行目を $\frac{84}{787}$ 倍

$$\left(\begin{array}{ccccc|c} 1 & 0 & -4 & -4 & -5 & 23 \\ 0 & 1 & \frac{27}{5} & \frac{18}{5} & \frac{36}{5} & -\frac{168}{5} \\ 0 & 0 & 1 & \frac{127}{168} & \frac{73}{56} & -\frac{101}{14} \\ 0 & 0 & 0 & 1 & -\frac{393}{787} & \frac{1572}{787} \end{array} \right)$$

3行目に4行目を $-\frac{127}{168}$ 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & 0 & -4 & -4 & -5 & 23 \\ 0 & 1 & \frac{27}{5} & \frac{18}{5} & \frac{36}{5} & -\frac{168}{5} \\ 0 & 0 & 1 & 0 & \frac{1323}{787} & -\frac{6866}{787} \\ 0 & 0 & 0 & 1 & -\frac{393}{787} & \frac{1572}{787} \end{array} \right)$$

2行目に4行目を $-\frac{18}{5}$ 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & 0 & -4 & -4 & -5 & 23 \\ 0 & 1 & \frac{27}{5} & 0 & \frac{35406}{3935} & -\frac{160512}{3935} \\ 0 & 0 & 1 & 0 & \frac{1323}{787} & -\frac{6866}{787} \\ 0 & 0 & 0 & 1 & -\frac{393}{787} & \frac{1572}{787} \end{array} \right)$$

1行目に4行目を4倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & 0 & -4 & 0 & -\frac{5507}{787} & \frac{24389}{787} \\ 0 & 1 & \frac{27}{5} & 0 & \frac{35406}{3935} & -\frac{160512}{3935} \\ 0 & 0 & 1 & 0 & \frac{1323}{787} & -\frac{6866}{787} \\ 0 & 0 & 0 & 1 & -\frac{393}{787} & \frac{1572}{787} \end{array} \right)$$

2行目に3行目を $-\frac{27}{5}$ 倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & 0 & -4 & 0 & -\frac{5507}{787} & \frac{24389}{787} \\ 0 & 1 & 0 & 0 & -\frac{63}{787} & \frac{4974}{787} \\ 0 & 0 & 1 & 0 & \frac{1323}{787} & -\frac{6866}{787} \\ 0 & 0 & 0 & 1 & -\frac{393}{787} & \frac{1572}{787} \end{array} \right)$$

1行目に3行目を4倍して、加える

$$\left(\begin{array}{ccccc|c} 1 & 0 & 0 & 0 & -\frac{215}{787} & -\frac{3075}{787} \\ 0 & 1 & 0 & 0 & -\frac{63}{787} & \frac{4974}{787} \\ 0 & 0 & 1 & 0 & \frac{1323}{787} & -\frac{6866}{787} \\ 0 & 0 & 0 & 1 & -\frac{393}{787} & \frac{1572}{787} \end{array} \right)$$

$$\begin{cases} x_1 = & \frac{215}{787}p_5 - \frac{3075}{787} \\ x_2 = & \frac{63}{787}p_5 + \frac{4974}{787} \\ x_3 = & -\frac{1323}{787}p_5 - \frac{6866}{787} \\ x_4 = & \frac{393}{787}p_5 + \frac{1572}{787} \\ x_5 = & p_5 \end{cases}$$