Algebra Linear

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1 Exercício 3

Considere o conjunto W = $\{(x, y, z, w, t, u) \mid x, y, z, w, t, u \in R \wedge x + y + w + z + t + u = 0 \wedge y - w - z = 0 \wedge w + t - x = 0\} \subseteq R^6$.
Mostre que conjunto W é um subespaço do R-espaço vetorial R^6.

$t - x = 0$
$t = x$
$y - w - z = 0$
$y = w + z$
$x + y + w + z + t + u = 0 \to x + w + z + w + z + x + u = 0$
$u = -x - y - w - z - t \to u = -2x - 2w - 2z$
$W = \{(x, w + z, z, w, x, -x - w - z - w - z - x)\} \to$
$W = \{(x, w + z, z, w, x, -2x - 2w - 2z) \mid x, z, w \in R\}$
I) $0 \in W$ parax $= 0z = 0w = 0$
(w, w, w, w, w, -w) $\to (x, w + z, z, w, x, -2x - 2w - 2z)$
$= (0, 0, 0, 0, 0, -0)$
$= 0$
Logo, $0 \in W$
II) u, v $\in W \to u + v \in W,$ sendo :

$u = (u1, u2, u3, u4, u5, -u6) \to (x_1, w_1 + z_1, z_1, w_1, x_1, -2x_1 - 2w_1 - 2z_1)$
$v = (v1, v2, v3, v4, v5, -v6) \to (x_2, w_2 + z_2, z_2, w_2, x_2, -2x_2 - 2w_2 - 2z_2)$
$u + v = (x_1 + x_2, (w_1 + z_1) + (w_2 + z2), z_1 + z_2, w_1 + w_2, x_1 + x_2, (-2x_1 - 2w_1 - 2z_2) + (-2x_2 - 2w_2 - 2z_2))$
$u + v = (x_1 x_2, w_1 z_1 w_2 z_2, z_1, z_2, w_1 + w_2, x_1 + x_2, -2x_1 - 2x_2, -2w_1 - 2w_2, -2z_1 - 2z_2)$
Logo, u + v $\in aoconjuntoW$
III)a $\in R, v \in W \to av \in W,$ sendo :
$v = (v1, v2, v3, v4, v5, -v6) \to (x, w + z, z, w, x, -2x - 2w - 2z)$
$av = a \cdot (x_1, w_1 + z_1, z_1, w_1, x_1, -2x_1 - 2w_1 - 2z_1)$
$av = (a.x_1, a.w_1 + z_1, a.z_1, a.w_1, a.x_1, a. - 2x_1 - 2w_1 - 2z_1)$
$av = (ax_1, aw_1 w_2, az_1, aw_1, ax_1, a - 2x_1 - 2w_1 - 2z_1)$
Logo, av $\in aoconjuntoW$
Logo o conjunto W é subespaço vetorial de R6.

- O conjunto W = $\{(x, y, z) \mid x, y, z \in R \wedge x - z = 1 \wedge y + x = 0\}$

é um subsespaço vetorial de R3? Esboce graficamente W.
$x - z = 1$ à $x = 1 + z$
$y + x = 0$ à $y + 1 + z = 0$ à $y = -1 - z$.
$W = \{(1 + z, -1 - z, z)\}$
I) $0 \in W$, paraz $= 0$
$(1 + z, -1 - z, z)$ à $(1 + 0, -1 - 0, 0) = (1, -1, 0)$.
Logo ,$0naopertencea$W$paraz$=$0. Portanto, W nosubespaovetorial.$

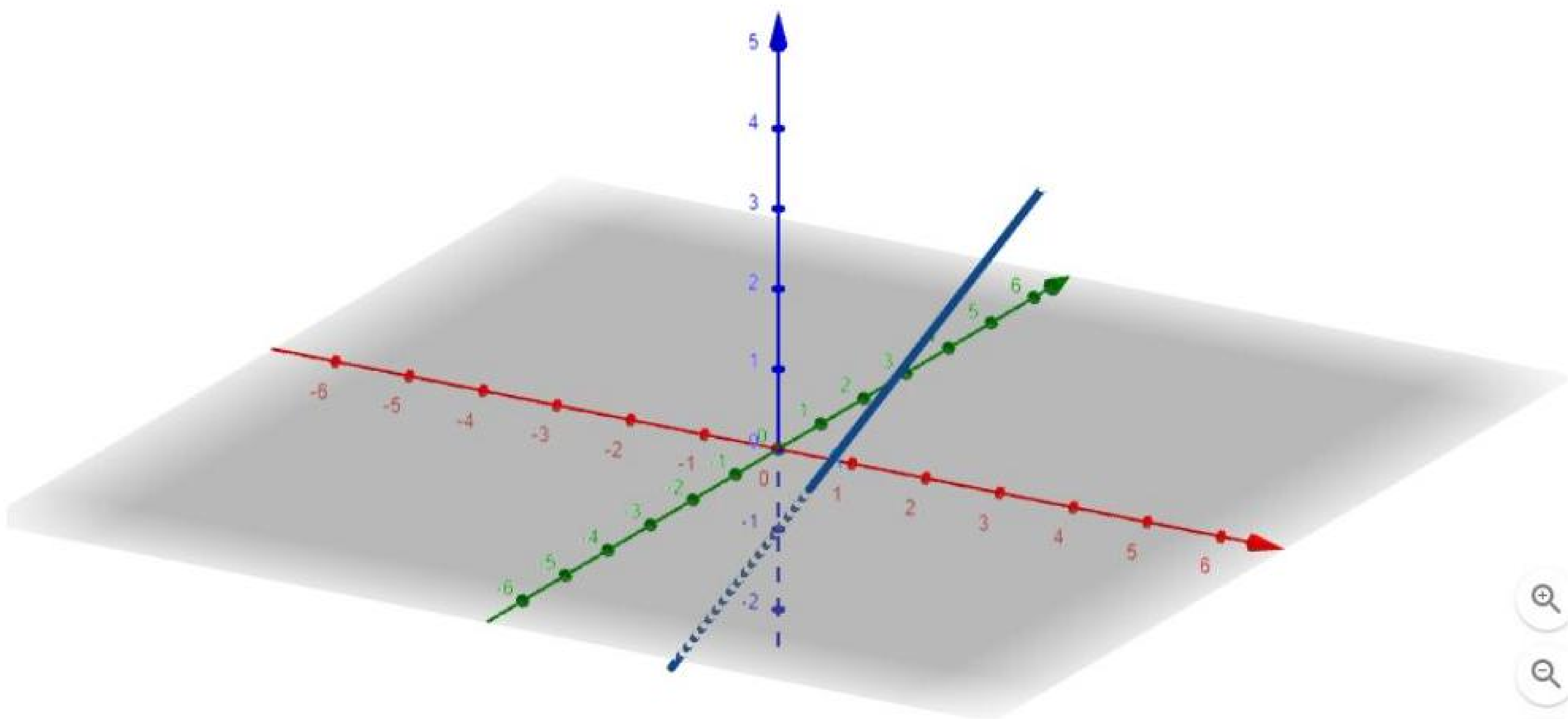

Figura 1: Representação gráfica do subespaço vetorial de R3.

- Invente seu subespaço vetorial em qualquer R n com n maior igual a 2. Mostre que o conjunto apresentado é de fato um subespaço vetorial. Não vale usar nenhum exemplo da aula ou da prova

$Z = \{(x, y, z) \mid 2y + z = 0 \wedge x + y = 0\}$
$2y + z = 0$
$x + y = 0$
$z = -2y$
$x = -y$
$Z = (-y, y, -2y)$
$Z = \{(-z, z, -z) \mid Z \in R\}$
I) $0 \in Z$, paraz $= 0$
(z, z, z) à $(-y, y, -2y)$
y à 0
$(-y, y, -2y) = (-0, 0, -0) = (0, 0, 0)$
Logo, $0 \in Z$ II) u, v $\in Z \to u + v \in Z$, sendo :
$u = (u1, u2, u3)$
$v = (v1, v2, v3)$ à $(-y, y, -2y)$
$u + v = (u1, u2, u3) + (-y, y, -2y)$
$u + v = (u1 - y, u2 + y, -u3 - 2y)$
Logo, $u + v \in Z$
III) a $\in$ R, v $\in Z \to av \in Z$. Sendo :
$v = (v1, v2, v3)$ à(-y, y, -2y)
$a.v = a \cdot (-y, y, -2y)$
$a.v = (a \cdot (-y), a \cdot y, a \cdot (-2y))$
$a.v = (-ay, ay, -a\,2y)$
Logo, av $\in Z$
Logo Z é subespaço vetorial de $R3$

2 Exercício 4

Mostre que o conjunto $\{(1, 1, 1, 1, 0, 1, 1), (1, 0, 1, 1, 1, 1, 0), (2, 2, 1, 1, 1, 1, 1), (1, 0, 0, 1, 2, 1, 1), (2, 0, 2, 0, 2, 0, 2), (1, 1, 1, 1, 1, 1, 1), (3, 0, 2, 0, 2, 1, 2)\}$ forma uma base para o Respaço vetorial R7. Escreva o vetor $(0, 1, 1, 1, 1, 0, 1)$ nesta base.

$$\xrightarrow{Incio} \left[\begin{array}{ccccccc|c} -1 & 1 & 2 & 1 & 2 & 1 & 3 & a \\ 1 & 0 & 2 & 0 & 0 & -1 & 0 & b \\ 1 & -1 & 1 & 0 & 2 & -1 & 2 & c \\ 1 & 1 & 1 & 1 & 0 & -1 & 0 & d \\ 0 & 1 & -1 & 2 & 2 & -1 & 2 & e \\ 1 & -1 & 1 & 1 & 0 & -1 & -1 & f \\ 1 & 0 & 1 & 1 & 2 & 1 & 2 & g \end{array}\right]$$

$$\xrightarrow{l2 \to l2+l1} \left[\begin{array}{ccccccc|c} -1 & 1 & 2 & 1 & 2 & 1 & 3 & a \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 1 & -1 & 1 & 0 & 2 & -1 & 2 & c \\ 1 & 1 & 1 & 1 & 0 & -1 & 0 & d \\ 0 & 1 & -1 & 2 & 2 & -1 & 2 & e \\ 1 & -1 & 1 & 1 & 0 & -1 & -1 & f \\ 1 & 0 & 1 & 1 & 2 & 1 & 2 & g \end{array}\right]$$

$$\xrightarrow{l3 \to l3+l1} \left[\begin{array}{ccccccc|c} -1 & 1 & 2 & 1 & 2 & 1 & 3 & a \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 3 & 1 & 4 & 0 & 5 & c+a \\ 1 & 1 & 1 & 1 & 0 & -1 & 0 & d \\ 0 & 1 & -1 & 2 & 2 & -1 & 2 & e \\ 1 & -1 & 1 & 1 & 0 & -1 & -1 & f \\ 1 & 0 & 1 & 1 & 2 & 1 & 2 & g \end{array}\right]$$

$$\xrightarrow{l4 \to l4+l1}$$

$$\left[\begin{array}{ccccccc|c} -1 & 1 & 2 & 1 & 2 & 1 & 3 & a \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 3 & 1 & 4 & 0 & 5 & c+a \\ 0 & 2 & 3 & 2 & 2 & 0 & 3 & d+a \\ 0 & 1 & -1 & 2 & 2 & -1 & 2 & e \\ 1 & -1 & 1 & 1 & 0 & -1 & -1 & f \\ 1 & 0 & 1 & 1 & 2 & 1 & 2 & g \end{array}\right]$$

$$\xrightarrow{l6 \to l6+l1} \left[\begin{array}{ccccccc|c} -1 & 1 & 2 & 1 & 2 & 1 & 3 & a \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 3 & 1 & 4 & 0 & 5 & c+a \\ 0 & 2 & 3 & 2 & 2 & 0 & 3 & d+a \\ 0 & 1 & -1 & 2 & 2 & -1 & 2 & e \\ 0 & 0 & 3 & 2 & 2 & 0 & 2 & f+a \\ 1 & 0 & 1 & 1 & 2 & 1 & 2 & g \end{array}\right] \xrightarrow{l7 \to l7+l1} \left[\begin{array}{ccccccc|c} -1 & 1 & 2 & 1 & 2 & 1 & 3 & a \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 3 & 1 & 4 & 0 & 5 & c+a \\ 0 & 2 & 3 & 2 & 2 & 0 & 3 & d+a \\ 0 & 1 & -1 & 2 & 2 & -1 & 2 & e \\ 0 & 0 & 3 & 2 & 2 & 0 & 2 & f+a \\ 0 & 1 & 3 & 2 & 4 & 2 & 5 & g+a \end{array}\right]$$

$$\xrightarrow{l1\to l1-l2}\left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 3 & 1 & 4 & 0 & 5 & c+a \\ 0 & 2 & 3 & 2 & 2 & 0 & 3 & d+a \\ 0 & 1 & -1 & 2 & 2 & -1 & 2 & e \\ 0 & 0 & 3 & 2 & 2 & 0 & 2 & f+a \\ 0 & 1 & 3 & 2 & 4 & 2 & 5 & g+a \end{array}\right]\xrightarrow{l4\to l4/2}\left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 3 & 1 & 4 & 0 & 5 & c+a \\ 0 & 1 & 3/2 & 0 & 0 & 0 & 3/2 & d+a/2 \\ 0 & 1 & -1 & 2 & 2 & -1 & 2 & e \\ 0 & 0 & 3 & 2 & 2 & 0 & 2 & f+a \\ 0 & 1 & 3 & 2 & 4 & 2 & 5 & g+a \end{array}\right]$$

$$\xrightarrow{l4\to l4-l2}\left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 3 & 1 & 4 & 0 & 5 & c+a \\ 0 & 0 & -5/2 & 0 & -1 & 0 & -3/2 & d+3a-2b/2 \\ 0 & 1 & -1 & 2 & 2 & -1 & 2 & e \\ 0 & 0 & 3 & 2 & 2 & 0 & 2 & f+a \\ 0 & 1 & 3 & 2 & 4 & 2 & 5 & g+a \end{array}\right]\xrightarrow{l5\to l5-l2}\left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 3 & 1 & 4 & 0 & 5 & c+a \\ 0 & 0 & -5/2 & 0 & -1 & 0 & -3/2 & d+3a-2b/2 \\ 0 & 0 & -5 & 1 & 0 & -1 & -1 & e-b+a \\ 0 & 0 & 3 & 2 & 2 & 0 & 2 & f+a \\ 0 & 1 & 3 & 2 & 4 & 2 & 5 & g+a \end{array}\right]$$

$$\xrightarrow{l7\to l7-l2}\left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 3 & 1 & 4 & 0 & 5 & c+a \\ 0 & 0 & -5/2 & 0 & -1 & 0 & -3/2 & d+3a-2b/2 \\ 0 & 0 & -5 & 1 & 0 & -1 & -1 & e-b+a \\ 0 & 0 & 3 & 2 & 2 & 0 & 2 & f+a \\ 0 & 0 & -1 & 1 & 2 & 2 & 2 & g+2a-b \end{array}\right]\xrightarrow{l3\to l3/3}\left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 & c+a/3 \\ 0 & 0 & -5/2 & 0 & -1 & 0 & -3/2 & d+3a-2b/5 \\ 0 & 0 & -5 & 1 & 0 & -1 & -1 & e-b+a \\ 0 & 0 & 3 & 2 & 2 & 0 & 2 & f+a \\ 0 & 0 & -1 & 1 & 2 & 2 & 2 & g+2a-b \end{array}\right]$$

$$\xrightarrow{l4\to -2.5.l4}\left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 & c+a/3 \\ 0 & 0 & 1 & 0 & 2/5 & 0 & 3/5 & -d+3a-2b/5 \\ 0 & 0 & -5 & 1 & 0 & -1 & -1 & e-b+a/5 \\ 0 & 0 & 3 & 2 & 2 & 0 & 2 & f+a \\ 0 & 0 & -1 & 1 & 2 & 2 & 2 & g+2a-b \end{array}\right]\xrightarrow{l5\to l5/5}\left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 & c+a/3 \\ 0 & 0 & 1 & 0 & 2/5 & 0 & 3/5 & -d+3a-2b/5 \\ 0 & 0 & -1 & 1/5 & 0 & -1/5 & -1/5 & e-b+a/5 \\ 0 & 0 & 3 & 2 & 2 & 0 & 2 & b+a/3 \\ 0 & 0 & -1 & 1 & 2 & 2 & 2 & g+2a-b \end{array}\right]$$

$$\xrightarrow{l6\to l6/3}\left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 & c+a/3 \\ 0 & 0 & 1 & 0 & 2/5 & 0 & 3/5 & \frac{-3d-14a+6b-2c}{15} \\ 0 & 0 & -1 & 1/5 & 0 & -1/5 & -1/5 & e-b+a/5 \\ 0 & 0 & 1 & 2/3 & 2/3 & 0 & 2/3 & f+a/3 \\ 0 & 0 & -1 & 1 & 2 & 2 & 2 & g+2a-b \end{array}\right]\xrightarrow{l4\to l4-l3}\left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 & c+a/3 \\ 0 & 0 & 0 & -1/3 & -14/15 & 0 & 16/15 & -3d-14a+6b-3c \\ 0 & 0 & -1 & 1/5 & 0 & -1/5 & -1/5 & e-b+a/5 \\ 0 & 0 & 1 & 2/3 & 2/3 & 0 & 2/3 & f+a/3 \\ 0 & 0 & -1 & 1 & 2 & 2 & 2 & g+2a-b \end{array}\right]$$

$$\xrightarrow{l5\to l5+l3}\left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 & c+a/3 \\ 0 & 0 & 0 & -1/3 & -14/15 & 0 & 16/15 & \frac{-3d-14a+6b-3c}{15} \\ 0 & 0 & 0 & 8/15 & 4/3 & -1/5 & 22/15 & \frac{8a+3e-3b+3c}{15} \\ 0 & 0 & 1 & 2/3 & 2/3 & 0 & 2/3 & f+a/3 \\ 0 & 0 & -1 & 1 & 2 & 2 & 2 & g+2a-b \end{array}\right]\xrightarrow{l6\to l6-l3}\left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 & c+a/3 \\ 0 & 0 & 0 & -1/3 & -14/15 & 0 & 16/15 & \frac{-3d-14a+6b-3c}{15} \\ 0 & 0 & 0 & 8/15 & 4/3 & -1/5 & 22/15 & \frac{8a+3e-3b+3c}{15} \\ 0 & 0 & 0 & 1/3 & -2/3 & 0 & -1 & f-c/3 \\ 0 & 0 & -1 & 1 & 2 & 2 & 2 & g+2a-b \end{array}\right]$$

$$\xrightarrow{l7\to l7+l3}\left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 & c+a/3 \\ 0 & 0 & 0 & -1/3 & -14/15 & 0 & 16/15 & \frac{-3d-14a+6b-3c}{15} \\ 0 & 0 & 0 & 8/15 & 4/3 & -1/5 & 22/15 & \frac{8a+3e-3b+3c}{15} \\ 0 & 0 & 0 & 1/3 & -2/3 & 0 & -1 & f-c/3 \\ 0 & 0 & 0 & 4/3 & 10/3 & 2 & 11/3 & \frac{3g+7a-3b+c}{3} \end{array}\right]\xrightarrow{l4\to 3.l4}\left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 & c+a/3 \\ 0 & 0 & 0 & 1 & 14/5 & 0 & 16/5 & \frac{-3d-14a+6b-3c}{5} \\ 0 & 0 & 0 & 8/15 & 4/3 & -1/5 & 22/15 & \frac{8a+3e-3b+3c}{15} \\ 0 & 0 & 0 & 1/3 & -2/3 & 0 & -1 & f-c/3 \\ 0 & 0 & 0 & 4/3 & 10/3 & 2 & 11/3 & \frac{3g+7a-3b+c}{3} \end{array}\right]$$

$$\xrightarrow{l5\to 15/8.l5}\left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 & c+a/3 \\ 0 & 0 & 0 & 1 & 14/5 & 0 & 16/5 & \frac{-3d-14a+6b-3c}{5} \\ 0 & 0 & 0 & 1 & 5/2 & -3/8 & 11/4 & \frac{8a+3e-3b+3c}{8} \\ 0 & 0 & 0 & 1/3 & -2/3 & 0 & -1 & f-c/3 \\ 0 & 0 & 0 & 4/3 & 10/3 & 2 & 11/3 & \frac{3g+7a-3b+c}{3} \end{array}\right]\xrightarrow{l6\to 3.l6}\left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 & c+a/3 \\ 0 & 0 & 0 & 1 & 14/5 & 0 & 16/5 & \frac{-3d-14a+6b-}{5} \\ 0 & 0 & 0 & 1 & 5/2 & -3/8 & 11/4 & \frac{8a+3e-3b+3c}{8} \\ 0 & 0 & 0 & 1 & -2 & 0 & -3 & f-c \\ 0 & 0 & 0 & 4/3 & 10/3 & 2 & 11/3 & \frac{3g+7a-3b+c}{3} \end{array}\right]$$

$$\xrightarrow{l5\to l5-l4}\left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 & c+a/3 \\ 0 & 0 & 0 & 1 & 14/5 & 0 & 16/5 & \frac{-3d-14a+6b-}{5} \\ 0 & 0 & 0 & 0 & -3/10 & -3/8 & -9/20 & \frac{8a+3e-3b+3c}{8} \\ 0 & 0 & 0 & 1 & -2 & 0 & -3 & f-c \\ 0 & 0 & 0 & 1 & 5/2 & 3/2 & 11/4 & \frac{3g+7a-3b+c}{4} \end{array}\right]\xrightarrow{l6\to l6-l4}\left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 & c+a/3 \\ 0 & 0 & 0 & 1 & 14/5 & 0 & 16/5 & \frac{-3d-14a+6b-}{5} \\ 0 & 0 & 0 & 0 & -3/10 & -3/8 & -9/20 & \frac{-72a+13e-+55b+15c-24d}{40} \\ 0 & 0 & 0 & 0 & -24/5 & 0 & -31/5 & f-c \\ 0 & 0 & 0 & 1 & 5/2 & 3/2 & 11/4 & \frac{3g+7a-3b+c}{4} \end{array}\right]$$

$$\xrightarrow{l7\to l7-l4}\left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 & \frac{c+a}{3} \\ 0 & 0 & 0 & 1 & 14/5 & 0 & 16/5 & -\frac{-3d-14a+6b-5c}{5} \\ 0 & 0 & 0 & 0 & -3/10 & -3/8 & -9/20 & \frac{-72a+15e+33b-15c-24d}{40} \\ 0 & 0 & 0 & 0 & -24/5 & 0 & -31/5 & \frac{5f-10c-3d-14a+6b}{5} \\ 0 & 0 & 0 & 0 & -3/10 & 3/2 & -9/20 & \frac{15g-21a+9b-15c-12d}{20} \end{array}\right]\xrightarrow{l5\to -10/3.l4}\left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 & \frac{c+a}{3} \\ 0 & 0 & 0 & 1 & 14/5 & 0 & 16/5 & -\frac{-3d-14a+6b-5c}{5} \\ 0 & 0 & 0 & 0 & 1 & 5/4 & 3/2 & -\frac{-24a+5e+11b-5c-8d}{4} \\ 0 & 0 & 0 & 0 & -24/5 & 0 & -31/5 & \frac{5f-10c-3d-14a+6b}{5} \\ 0 & 0 & 0 & 0 & -3/10 & 3/2 & -9/20 & \frac{15g-21a+9b-15c-12d}{20} \end{array}\right]$$

$$\xrightarrow{l6\to -5/24.l6}\left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 & \frac{c+a}{3} \\ 0 & 0 & 0 & 1 & 14/5 & 0 & 16/5 & -\frac{-3d-14a+6b-5c}{5} \\ 0 & 0 & 0 & 0 & 1 & 5/4 & 3/2 & -\frac{-24a+5e+11b-5c-8d}{4} \\ 0 & 0 & 0 & 0 & 1 & 0 & 31/24 & -\frac{5f-10c-3d-14a+6b}{24} \\ 0 & 0 & 0 & 0 & -3/10 & 3/2 & -9/20 & \frac{15g-21a+9b-15c-12d}{20} \end{array}\right]\xrightarrow{l7\to -10/3.l7}\left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 & \frac{c+a}{3} \\ 0 & 0 & 0 & 1 & 14/5 & 0 & 16/5 & -\frac{-3d-14a+6b-5c}{5} \\ 0 & 0 & 0 & 0 & 1 & 5/4 & 3/2 & -\frac{-24a+5e+11b-5c-8d}{4} \\ 0 & 0 & 0 & 0 & 1 & 0 & 31/24 & -\frac{5f-10c-3d-14a+6b}{24} \\ 0 & 0 & 0 & 0 & 1 & -5 & 3/2 & -\frac{5g+7a+3b-5c-4d}{2} \end{array}\right]$$

$$\xrightarrow{l6\to l6-l5}\left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 & \frac{c+a}{3} \\ 0 & 0 & 0 & 1 & 14/5 & 0 & 16/5 & -\frac{-3d-14a+6b-5c}{5} \\ 0 & 0 & 0 & 0 & 1 & 5/4 & 3/2 & -\frac{-24a+5e+11b-5c-8d}{4} \\ 0 & 0 & 0 & 0 & 0 & -5/4 & -5/24 & \frac{-20c+30e-5f-45d-130a+60b}{24} \\ 0 & 0 & 0 & 0 & 1 & -5 & 3/2 & -\frac{5g+7a+3b-5c-4d}{2} \end{array}\right]\xrightarrow{l7\to l7-l5}\left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 & \frac{c+a}{3} \\ 0 & 0 & 0 & 1 & 14/5 & 0 & 16/5 & -\frac{-3d-14a+6b-5c}{5} \\ 0 & 0 & 0 & 0 & 1 & 5/4 & 3/2 & -\frac{-24a+5e+11b-5c-8d}{4} \\ 0 & 0 & 0 & 0 & 0 & -5/4 & -5/24 & \frac{-20c+30e-5f-45d-130a+60b}{24} \\ 0 & 0 & 0 & 0 & 0 & -25/4 & 0 & \frac{-38a+5e-10g+5b+5c}{4} \end{array}\right]$$

$$\xrightarrow{l6\to -4/5.l6}\left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 & \frac{c+a}{3} \\ 0 & 0 & 0 & 1 & 14/5 & 0 & 16/5 & -\frac{-3d-14a+6b-5c}{5} \\ 0 & 0 & 0 & 0 & 1 & 5/4 & 3/2 & -\frac{-24a+5e+11b-5c-8d}{4} \\ 0 & 0 & 0 & 0 & 0 & 1 & 1/6 & -\frac{-4c+6e-f-9d-26a+12b}{6} \\ 0 & 0 & 0 & 0 & 0 & -25/4 & 0 & \frac{-38a+5e-10g+5b+5c}{4} \end{array}\right]\xrightarrow{l7\to -4/25.l7}\left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 & \frac{c+a}{3} \\ 0 & 0 & 0 & 1 & 14/5 & 0 & 16/5 & -\frac{-3d-14a+6b-5c}{5} \\ 0 & 0 & 0 & 0 & 1 & 5/4 & 3/2 & -\frac{-24a+5e+11b-5c-8d}{4} \\ 0 & 0 & 0 & 0 & 0 & 1 & 1/6 & -\frac{-4c+6e-f-9d-26a+12b}{6} \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & -\frac{-38a+5e-10g+5b+5c}{4} \end{array}\right]$$

$$\xrightarrow{l7\to l7-l6}\left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 & \frac{c+a}{3} \\ 0 & 0 & 0 & 1 & 14/5 & 0 & 16/5 & -\frac{-3d-14a+6b-5c}{5} \\ 0 & 0 & 0 & 0 & 1 & 5/4 & 3/2 & -\frac{-24a+5e+11b-5c-8d}{4} \\ 0 & 0 & 0 & 0 & 0 & 1 & 1/6 & -\frac{-4c+6e-f-9d-26a+12b}{6} \\ 0 & 0 & 0 & 0 & 0 & 0 & -1/6 & \frac{120e-422a+270b-130c-225d+60g-25f}{150} \end{array}\right]\xrightarrow{l7\to -6.l7}\left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 & \frac{c+a}{3} \\ 0 & 0 & 0 & 1 & 14/5 & 0 & 16/5 & -\frac{-3d-14a+6b-5c}{5} \\ 0 & 0 & 0 & 0 & 1 & 5/4 & 3/2 & -\frac{-24a+5e+11b-5c-8d}{4} \\ 0 & 0 & 0 & 0 & 0 & 1 & 1/6 & -\frac{-4c+6e-f-9d-26a+12b}{6} \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & -\frac{120e-422a+270b-130c-225d+60g-25f}{25} \end{array}\right]$$

$$\xrightarrow{l6\to l6-(1/6.l7)} \left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 & \frac{c+a}{3} \\ 0 & 0 & 0 & 1 & 14/5 & 0 & 16/5 & -\frac{-3d-14a+6b-5c}{5} \\ 0 & 0 & 0 & 0 & 1 & 5/4 & 3/2 & \frac{-24a+5e+11b-5c-8d}{4} \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & \frac{10g-5e-5c+38a-5b}{25} \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & -\frac{120e-422a+270b-130c-225d+60g-25f}{25} \end{array}\right] \xrightarrow{l5\to l5-(3/2.l7)} \left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 & \frac{c+a}{3} \\ 0 & 0 & 0 & 1 & 14/5 & 0 & 16/5 & -\frac{-3d-14a+6b-5c}{5} \\ 0 & 0 & 0 & 0 & 1 & 5/4 & 0 & \frac{595e-1932a+1345b-655c+1150d+360g-150f}{100} \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & \frac{10g-5e-5c+38a-5b}{25} \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & -\frac{120e-422a+270b-130c-225d+60g-25f}{25} \end{array}\right]$$

$$\xrightarrow{l4\to l4-(16/5.l7)} \left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 & \frac{c+a}{3} \\ 0 & 0 & 0 & 1 & 14/5 & 0 & 0 & \frac{1920e-3525d-3402a+4170b-1955c+960g-400f}{125} \\ 0 & 0 & 0 & 0 & 1 & 5/4 & 0 & \frac{595e-1932a+1345b-655c+1150d+360g-150f}{50} \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & \frac{10g-5e-5c+38a-5b}{25} \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & -\frac{120e-422a+270b-130c-225d+60g-25f}{25} \end{array}\right] \xrightarrow{l3\to l3-(5/3.l7)} \left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 0 & \frac{120e-125c-417a+270b-255d+60g-25f}{15} \\ 0 & 0 & 0 & 1 & 14/5 & 0 & 0 & \frac{1920e-3525d-3402a+4170b-1955c+960g-400f}{125} \\ 0 & 0 & 0 & 0 & 1 & 5/4 & 0 & \frac{595e-1932a+1345b-655c+1150d+360g-150f}{50} \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & \frac{10g-5e-5c+38a-5b}{25} \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & -\frac{120e-422a+270b-130c-225d+60g-25f}{25} \end{array}\right]$$

$$\xrightarrow{l2\to l2-(3.l7)} \left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 0 & \frac{360e+835b-1214a-390c-675d+180g-75f}{25} \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 0 & \frac{120e-125c-417a+270b-255d+60g-25f}{15} \\ 0 & 0 & 0 & 1 & 14/5 & 0 & 0 & \frac{1920e-3525d-3402a+4170b-1955c+960g-400f}{125} \\ 0 & 0 & 0 & 0 & 1 & 5/4 & 0 & \frac{595e-1932a+1345b-655c+1150d+360g-150f}{50} \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & \frac{10g-5e-5c+38a-5b}{25} \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & -\frac{120e-422a+270b-130c-225d+60g-25f}{25} \end{array}\right] \xrightarrow{l5\to l5-(5/4.l6)} \left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 0 & \frac{360e+835b-1214a-390c-675d+180g-75f}{25} \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 0 & \frac{120e-125c-417a+270b-255d+60g-25f}{15} \\ 0 & 0 & 0 & 1 & 14/5 & 0 & 0 & \frac{1920e-3525d-3402a+4170b-1955c+960g-400f}{125} \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & \frac{60e-1061a+685b-315c+575d+155g-75f}{50} \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & \frac{10g-5e-5c+38a-5b}{25} \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & -\frac{120e-422a+270b-130c-225d+60g-25f}{25} \end{array}\right]$$

$$\xrightarrow{l1\to l1-l6} \left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 0 & 0 & \frac{12a+5e+30b-10g+5c}{25} \\ 0 & 1 & 4 & 1 & 2 & 0 & 0 & \frac{360e+835b-1214a-390c-675d+180g-75f}{25} \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 0 & \frac{120e-125c-417a+270b-255d+60g-25f}{15} \\ 0 & 0 & 0 & 1 & 14/5 & 0 & 0 & \frac{1920e-3525d-3402a+4170b-1955c+960g-400f}{125} \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & \frac{60e-1061a+685b-315c+575d+155g-75f}{50} \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & \frac{10g-5e-5c+38a-5b}{25} \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & -\frac{120e-422a+270b-130c-225d+60g-25f}{25} \end{array}\right] \xrightarrow{l4\to l4-(14/5.l5)} \left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 0 & 0 & \frac{12a+5e+30b-10g+5c}{25} \\ 0 & 1 & 4 & 1 & 2 & 0 & 0 & \frac{360e+835b-1214a-390c-675d+180g-75f}{25} \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 0 & \frac{120e-125c-417a+270b-255d+60g-25f}{15} \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & \frac{16g+60e-302d+161a-25b+10c-16f}{5} \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & \frac{60e-1061a+685b-315c+575d+155g-75f}{50} \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & \frac{10g-5e-5c+38a-5b}{25} \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & -\frac{120e-422a+270b-130c-225d+60g-25f}{25} \end{array}\right]$$

$$\xrightarrow{l3\to l3-(4/3.l5)} \left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 0 & 0 & \frac{12a+5e+30b-10g+5c}{25} \\ 0 & 1 & 4 & 1 & 2 & 0 & 0 & \frac{360e+835b-1214a-390c-675d+180g-75f}{25} \\ 0 & 0 & 1 & 1/3 & 0 & 0 & 0 & \frac{260g+620e-605c-2237a+1370b-1275d-125f}{75} \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & \frac{16g+60e-302d+161a-25b+10c-16f}{5} \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & \frac{60e-1061a+685b-315c+575d+155g-75f}{50} \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & \frac{10g-5e-5c+38a-5b}{25} \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & -\frac{120e-422a+270b-130c-225d+60g-25f}{25} \end{array}\right] \xrightarrow{l2\to l2-(2.l5)} \left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 0 & 0 & \frac{12a+5e+30b-10g+5c}{25} \\ 0 & 1 & 4 & 1 & 0 & 0 & 0 & \frac{74e+169b-258a-76c-135d+32g-15f}{5} \\ 0 & 0 & 1 & 1/3 & 0 & 0 & 0 & \frac{260g+620e-605c-2237a+1370b-1275d-125f}{75} \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & \frac{16g+60e-302d+161a-25b+10c-16f}{5} \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & \frac{60e-1061a+685b-315c+575d+155g-75f}{50} \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & \frac{10g-5e-5c+38a-5b}{25} \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & -\frac{120e-422a+270b-130c-225d+60g-25f}{25} \end{array}\right]$$

$$\xrightarrow{l3\to l3-(1/3.l4)} \left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 0 & 0 & \frac{12a+5e+30b-10g+5c}{25} \\ 0 & 1 & 4 & 1 & 0 & 0 & 0 & \frac{74e+169b-258a-76c-135d+32g-15f}{5} \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & \frac{180g+320e-655c-3042a+1495b+235d-45f}{75} \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & \frac{16g+60e-302d+161a-25b+10c-16f}{5} \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & \frac{60e-1061a+685b-315c+575d+155g-75f}{50} \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & \frac{10g-5e-5c+38a-5b}{25} \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & -\frac{120e-422a+270b-130c-225d+60g-25f}{25} \end{array}\right] \xrightarrow{l2\to l2-l4} \left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 0 & 0 & \frac{12a+5e+30b-10g+5c}{25} \\ 0 & 1 & 4 & 0 & 0 & 0 & 0 & \frac{16g+14e+194b-419a-86c+167d+f}{5} \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & \frac{180g+320e-655c-3042a+1495b+235d-45f}{75} \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & \frac{16g+60e-302d+161a-25b+10c-16f}{5} \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & \frac{60e-1061a+685b-315c+575d+155g-75f}{50} \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & \frac{10g-5e-5c+38a-5b}{25} \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & -\frac{120e-422a+270b-130c-225d+60g-25f}{25} \end{array}\right]$$

$$\xrightarrow{l2\to l2-(4.l3)} \left[\begin{array}{ccccccc|c} -1 & 0 & -2 & 0 & 0 & 0 & 0 & \frac{12a+5e+30b-10g+5c}{25} \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & \frac{-480g-1070e-3070b+5883a+1330c+1565d+195f}{75} \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & \frac{180g+320e-655c-3042a+1495b+235d-45f}{75} \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & \frac{16g+60e-302d+161a-25b+10c-16f}{5} \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & \frac{60e-1061a+685b-315c+575d+155g-75f}{50} \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & \frac{10g-5e-5c+38a-5b}{25} \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & -\frac{120e-422a+270b-130c-225d+60g-25f}{25} \end{array}\right] \xrightarrow{l1\to l1+(2.l3)} \left[\begin{array}{ccccccc|c} -1 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{330g+655e-6048a+3080b-1295c+470d-90f}{75} \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & \frac{-480g-1070e-3070b+5883a+1330c+1565d+195f}{75} \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & \frac{180g+320e-655c-3042a+1495b+235d-45f}{75} \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & \frac{16g+60e-302d+161a-25b+10c-16f}{5} \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & \frac{60e-1061a+685b-315c+575d+155g-75f}{50} \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & \frac{10g-5e-5c+38a-5b}{25} \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & -\frac{120e-422a+270b-130c-225d+60g-25f}{25} \end{array}\right]$$

$$\xrightarrow{l1\to -1.l1} \left[\begin{array}{ccccccc|c} 1 & 0 & 0 & 0 & 0 & 0 & 0 & -\frac{330g+655e-6048a+3080b-1295c+470d-90f}{75} \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & \frac{-480g-1070e-3070b+5883a+1330c+1565d+195f}{75} \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & \frac{180g+320e-655c-3042a+1495b+235d-45f}{75} \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & \frac{16g+60e-302d+161a-25b+10c-16f}{5} \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & \frac{60e-1061a+685b-315c+575d+155g-75f}{50} \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & \frac{10g-5e-5c+38a-5b}{25} \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & -\frac{120e-422a+270b-130c-225d+60g-25f}{25} \end{array}\right]$$

3 Coordenadas

Portanto o conjunto forma base para o espaço vetorial R7 e as coordenadas são B $= \frac{216}{5}$; -23; 21; $\frac{-241}{5}$; $\frac{217}{10}$; 15; $\frac{19}{5}$