Algebra Linear

Anabelle Elizabeth Araújo de Souza
Pedro Henrique Levy Fermino Ferreira

29/10/2022

1 Exercício 1

Considere as bases do Respaço vetorial R3, A = {(4, 2, 0),(1, 1, 1),(5, 3, 3)} e B = {(1, 2, 1),(1, 5, 2),(1, 0, 1)}. Exiba as matrizes de mudança de base MB→A e MA→B. Escreva também os vetores abaixo nas bases indicadas:
- v = (0, 1, 2)A em B
- v = (1, 3, 1)B em A

Mudança B $\rightarrow A(b1)$
x. $a_1 + y.a_2 + z.a_3 = b_1$

x.(4, 2, 0) + y.(1, -1, 1) + z.(5, 3, 3) = (1, -2, 1)

$4x + y + 5z = 1$
$2x - y + 3z = -2$
$y + 3z = 1$

$4x + y + 5z = 1$
$2x - y + 3z = -2$
$6x + 8z = -1$

$2x - y + 3z = -2$
$y + 3z = 1$
$2x + 6z = -1$

$6x + 8z = -1$
$2x + 6z = -1(-3)$

$6x + 8z = -1$
$-6x - 18z = 3$

$-10z = 2$
$z = -2/10$
$z = -\mathbf{1/5}$

$2x + 6z = -1$
$2x + 6 \cdot (-1/5) = -1$

$\mathbf{x = 1/10}$

$y + 3z = 1$
$y + 3(-1/5) = 1$
$-1 + 3/5$
$\mathbf{y = 8/5}$

Mudança B $\rightarrow A(b2)$

Mudança B $\rightarrow A(b3)$

$4x + y + 5z = 1$
$2x - y + 3z = 0$
$y + 3z = 1$

$4x + y = 5z = 1$
$2x - y + 3z = 0$

$2x - y + 3z = 0$
$y + 3z = 1$
$6x + 8z = 1$

$2x + 6z = 1$
$\mathbf{x = -1/10}$

$\mathbf{z = 1/5}$

$y + 3(1/5) = 1$
$y + 3/5 = 1$
$\mathbf{y = 2/5}$

Mudança A $\rightarrow B(a1)$
x. b$_1 + y.b_2 + z.b_3 = a_1$

x.(1, -2, 1) + y.(1, 5, 2) + z.(1, 0, 1) = (4, 2, 0)

$x + y + z = 4$
$-2x + 5y = 2$
$x + 2y + z = 0$

$x + y + z = 4(.2\}$
$-2x + 5y = 2$

$x + y + z = 4$
$x + 2y + 2 = 0(-1)$

$-2x + 2y + 2z = 8$
$-2x + 5y = 2$

$7y + 2z = 10$

$x + y + z = 4$
$-x - 2y - z = 0$
$-y = 4$
$\mathbf{y = -4}$

$-2x + 5(-4) = 2$
-20
$-2x = 2$
$-2x = 22$
$\mathbf{x = -11}$

$7y + 2z = 10$
$7.(-4) + 2z = 10$
$\mathbf{z = 19}$

Mudança A $\rightarrow B(a2)$

x + y + z = 1
-2x + 5y = -1
x + 2y + z = 1

x + y + z = 1 .(2)
$-2x + 5y = -1$

$x + y + z = 1$
$z = 2y + z = 1$

$2x + 2y = 2z = 2$
$-2x + 5y = -1$

$7y + 2z = 1$
$\mathbf{y = 0}$

$7.0 + 2z = 1$
$\mathbf{z = 1/2}$

$-2x + 0 = -1$
$-2x + 0 = -1$
$-2x = -1$
$\mathbf{x = 1/2}$

Mudança A $\rightarrow B(a3)$

x + y + z = 5
-2x + 5y = 3
x + 2y + z = 3

x + y + z = 5
-2x + 5y = 3

x + y + z = 5
x + 2y + z = 3

7y + 2z = 13
y = -2

7y + 2z = 13
y = -2

7 . (-2) = 2z = 13
z = 27/2

-2x + 5(-2) = 3
-2x - 10 = 13
-2x = 13
x = -13/2

$$\mathbf{M_B \rightarrow_A}: \begin{bmatrix} \frac{1}{10} & -1 & \frac{-1}{10} \\ \frac{8}{5} & \frac{-5}{2} & \frac{2}{5} \\ \frac{-1}{5} & \frac{3}{2} & \frac{1}{5} \end{bmatrix} . \begin{bmatrix} 1 \\ 3 \\ -1 \end{bmatrix} \rightarrow \begin{bmatrix} \frac{1}{10}{}_*1 & -1_*3 & \frac{-1}{10}{}_*(-1) \\ \frac{8}{5}{}_*1 & \frac{-5}{2}{}_*3 & \frac{2}{5}{}_*(-1) \\ \frac{-1}{5}{}_*! & \frac{3}{2}{}_*3 & \frac{1}{5}{}_*(-1) \end{bmatrix} = \begin{bmatrix} \frac{-14}{5} \\ \frac{-63}{10} \\ \frac{41}{10} \end{bmatrix}$$

$$\mathbf{M}_A \rightarrow_B\colon \begin{bmatrix} -11 & \frac{1}{2} & \frac{-13}{2} \\ 4 & 0 & -2 \\ 19 & \frac{1}{2} & \frac{27}{2} \end{bmatrix} \cdot \begin{bmatrix} 0 \\ 1 \\ 2 \end{bmatrix} \rightarrow \begin{bmatrix} -11_*0 & \frac{1}{2}{}_*1 & \frac{-13}{2}{}_*2 \\ 4_*0 & 0_*1 & -2_*2 \\ 19_*0 & \frac{1}{2}{}_*1 & \frac{27}{2}{}_*2 \end{bmatrix} = \begin{bmatrix} \frac{-25}{2} \\ -4 \\ \frac{55}{2} \end{bmatrix}$$

2 Exercício 2

Considere o conjunto S = {(1, 1, 1, 1, 1),(2, 0, 1, 1, 3),(3, 1, 0, 2, 4),(2, 2, 5, 8, 1),(0, 1, 0, 2, 3)}.

- **S é LI ou LD?**

$$\mathbf{S} = \left[\begin{array}{ccccc|c} 1 & 2 & 3 & 2 & 0 & 0 \\ 1 & 0 & 1 & 2 & 1 & 0 \\ 1 & -1 & 0 & 5 & 0 & 0 \\ 1 & 1 & 2 & 8 & 2 & 0 \\ 1 & 3 & 4 & -1 & 3 & 0 \end{array}\right] \mathbf{l3}\leftarrow l4 - l3 \left[\begin{array}{ccccc|c} 1 & 2 & 3 & 2 & 0 & 0 \\ 1 & 0 & 1 & 2 & 1 & 0 \\ 0 & 2 & 2 & 3 & 2 & 0 \\ 1 & 1 & 2 & 8 & 2 & 0 \\ 1 & 3 & 4 & -1 & 3 & 0 \end{array}\right]$$

$$\mathbf{l1}\rightarrow l1 - l2 \left[\begin{array}{ccccc|c} 0 & 2 & 2 & 0 & -1 & 0 \\ 1 & 0 & 1 & 2 & 1 & 0 \\ 0 & 2 & 2 & 3 & 2 & 0 \\ 1 & 1 & 2 & 8 & 2 & 0 \\ 1 & 3 & 4 & -1 & 3 & 0 \end{array}\right] l3 \rightarrow l3 - l1 \left[\begin{array}{ccccc|c} 0 & 2 & 2 & 0 & -1 & 0 \\ 1 & 0 & 1 & 2 & 1 & 0 \\ 0 & 0 & 0 & 3 & 1 & 0 \\ 1 & 1 & 2 & 8 & 2 & 0 \\ 1 & 3 & 4 & -1 & 3 & 0 \end{array}\right]$$

$$l2 \rightarrow l2 - l3 \left[\begin{array}{ccccc|c} 0 & 2 & 2 & 0 & -1 & 0 \\ 1 & 0 & 1 & -1 & 0 & 0 \\ 0 & 0 & 0 & 3 & 1 & 0 \\ 1 & 1 & 2 & 8 & 2 & 0 \\ 1 & 3 & 4 & -1 & 3 & 0 \end{array}\right] l4 \rightarrow l4 - 3l3 \left[\begin{array}{ccccc|c} 0 & 2 & 2 & 0 & -1 & 0 \\ 1 & 0 & 1 & -1 & 0 & 0 \\ 0 & 0 & 0 & 3 & 1 & 0 \\ 1 & 1 & 2 & -1 & -1 & 0 \\ 1 & 3 & 4 & -1 & 3 & 0 \end{array}\right]$$

$$l5 \rightarrow l5 - l1 \left[\begin{array}{ccccc|c} 0 & 2 & 2 & 0 & -1 & 0 \\ 1 & 0 & 1 & -1 & 0 & 0 \\ 0 & 0 & 0 & 3 & 1 & 0 \\ 1 & 1 & 2 & -1 & -1 & 0 \\ 1 & 1 & 2 & -1 & 4 & 0 \end{array}\right] l5 \rightarrow l5 - l4 \left[\begin{array}{ccccc|c} 0 & 2 & 2 & 0 & -1 & 0 \\ 1 & 0 & 1 & -1 & 0 & 0 \\ 0 & 0 & 0 & 3 & 1 & 0 \\ 1 & 1 & 2 & -1 & -1 & 0 \\ 0 & 0 & 0 & -0 & 5 & 0 \end{array}\right]$$

$$l5 \rightarrow l5/5 \left[\begin{array}{ccccc|c} 0 & 2 & 2 & 0 & -1 & 0 \\ 1 & 0 & 1 & -1 & 0 & 0 \\ 0 & 0 & 0 & 3 & 1 & 0 \\ 1 & 1 & 2 & -1 & -1 & 0 \\ 0 & 0 & 0 & -0 & 1 & 0 \end{array}\right] l1 \rightarrow l5 + l1 \left[\begin{array}{ccccc|c} 0 & 2 & 2 & 0 & 0 & 0 \\ 1 & 0 & 1 & -1 & 0 & 0 \\ 0 & 0 & 0 & 3 & 1 & 0 \\ 1 & 1 & 2 & -1 & -1 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \end{array}\right]$$

$$l4 \rightarrow l4 - l1 \left[\begin{array}{ccccc|c} 0 & 2 & 2 & 0 & 0 & 0 \\ 1 & 0 & 1 & -1 & 0 & 0 \\ 0 & 0 & 0 & 3 & 1 & 0 \\ 1 & -1 & 0 & -1 & -1 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \end{array}\right] l3 \rightarrow l3 - l5 \left[\begin{array}{ccccc|c} 0 & 2 & 2 & 0 & 0 & 0 \\ 1 & 0 & 1 & -1 & 0 & 0 \\ 0 & 0 & 0 & 3 & 0 & 0 \\ 1 & -1 & 0 & -1 & -1 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \end{array}\right]$$

$$l3 \leftrightarrow 14 \left[\begin{array}{ccccc|c} 0 & 2 & 2 & 0 & 0 & 0 \\ 1 & 0 & 1 & -1 & 0 & 0 \\ 1 & -1 & 0 & -1 & -1 & 0 \\ 0 & 0 & 0 & 3 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \end{array}\right] l4 \rightarrow l4/3 \left[\begin{array}{ccccc|c} 0 & 2 & 2 & 0 & 0 & 0 \\ 1 & 0 & 1 & -1 & 0 & 0 \\ 1 & -1 & 0 & -1 & -1 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \end{array}\right]$$

$$l2 \rightarrow 12 + l4 \left[\begin{array}{ccccc|c} 0 & 2 & 2 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 & 0 & 0 \\ 1 & -1 & 0 & -1 & -1 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \end{array}\right] l3 \rightarrow l3 + l5 \left[\begin{array}{ccccc|c} 0 & 2 & 2 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 & 0 & 0 \\ 1 & -1 & 0 & -1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \end{array}\right]$$

$$l3 \rightarrow 13 + l4 \left[\begin{array}{ccccc|c} 0 & 2 & 2 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 & 0 & 0 \\ 1 & -1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \end{array}\right] l1 \rightarrow 2l2 - l1 \left[\begin{array}{ccccc|c} 2 & -2 & 0 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 & 0 & 0 \\ 1 & -1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \end{array}\right]$$

$$l3 \rightarrow -l3 \left[\begin{array}{ccccc|c} 2 & -2 & 0 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 & 0 & 0 \\ -1 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \end{array}\right] l1 \rightarrow 2l3 - l1 \left[\begin{array}{ccccc|c} 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 & 0 & 0 \\ -1 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \end{array}\right]$$

R: Portanto, é LD

Forma base do R-espaço vetorial R5?
R: Não forma base, pois é LD

3 Exercício 3

Considere o conjunto W = {(x, y, z, w, t, u) | $x, y, z, w, t, u \in R \wedge x + y + w + z + t + u = 0 \wedge y - w - z = 0 \wedge w + t - x = 0\} \subseteq R^6$.
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 → $x + w + z + w + z + x + u = 0$
u = -x -y -w -z -t → $u = -2x - 2w - 2z$
W = {(x, w + z, z, w, x, - x − w − z − w − z − x)} →
W = {(x, w + z, z, w, x, - 2x − 2w − 2z)| $x, z, w \in R$}

I) $0 \in W para x = 0 z = 0 w = 0$
(w, w, w, w, w, -w) → $(x, w + z, z, w, x, -2x–2w–2z)$
= (0, 0, 0, 0, 0, -0)
= 0
Logo, $0 \in W$

II) u, v $\in W \rightarrow u + v \in W, sendo:$
u = (u1, u2, u3, u4, u5, -u6) → $(x_1, w_1 + z_1, z_1, w_1, x_1, -2x_1–2w_1–2z_1)$
v = (v1, v2, v3, v4, v5, -v6) → $(x_2, w_2 + z_2, z_2, w_2, x_2, -2x_2–2w_2–2z_2)$
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 $\in W$

III) a $\in R, v \in W \rightarrow av \in W, sendo:$
v = (v1, v2, v3, v4, v5, -v6) → $(x, w + z, z, w, x, -2x–2w–2z)$
av = a . ($x_1, w_1 + z_1, z_1, w_1, x_1, -2x_1 - 2w_1 - 2z_1)$
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 = (a$x_1, aw_1w_2, az_1, aw_1, ax_1, a - 2x_1 - 2w_1 - 2z_1)$
Logo, av $\in W$.

Logo W é subespaço vetorial de R6.

- O conjunto W = {(x, y, z) | $x, y, z \in R \wedge x - z = 1 \wedge y + x = 0\}$
é um subespaço 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) $0 \in W, para z = 0$
(1 + z, - 1 − z, z) → $(1 + 0, -1–0, 0) = (1, -1, 0)$.
Logo 0 NÃO pertence a W para z = 0. Portanto, W NÃO é subespaço vetorial.

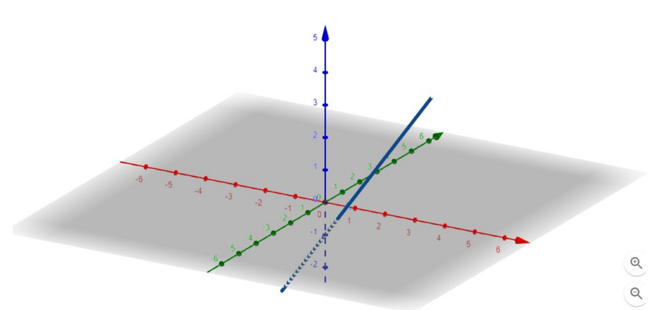

Figure 1: Representação gráfica.

- 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) | $2y + z = 0 \wedge x + y = 0\}$
2y + z = 0
x + y = 0
z = -2y
x = -y
Z= (-y, y, -2y)
Z = {(-z, z, -z) | $Z \in R\}$

I)$0 \in Z, para z = 0$
(z, z, z) → $(-y, y, -2y)$
y → 0
(-y, y, -2y) = (-0, 0, -0) = (0, 0, 0)
Logo, $0 \in Z$

II) u, v $\in Z \rightarrow u + v \in Z, sendo:$
u = (-y1, y1, -2y1)
v = (-y2, y2, -2y2)
u + v = (-y, y, -2y) + (-y2, y2, -2y2)
u + v = (-y1-y2, y1+y2, -2y-2y2)
Logo, u + v $\in Z$

III) a $\in R, v \in Z \rightarrow av \in Z.Sendo:$
v = (v1,v2,v3) → $(-y, y, -2y)$
a.v = a . (-y, y, -2y)
a.v = (a . (-y), a . y, a . (-2y))

a.v = (-ay, ay, -a2y)
Logo, av $\in Z$

Logo Z é subespaço vetorial de R3

4 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.

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

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

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

$l4 \rightarrow l4 + l1$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

5 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; $\frac{19}{5}$