Algebra Linear

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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 \rightarrow A e MA \rightarrow B. Escreva também os vetores abaixo nas bases indicadas:

• 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 = 12x - y + 3z = -2y + 3z = 1

4x + y + 5z = 12x - y + 3z = -2

6x + 8z = -1

2x - y + 3z = -2y + 3z = 12x + 6z = -1

6x + 8z = -1

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

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

-10z = 2z = -2/10

z = -1/52x + 6z = -1

 $2x + 6 \cdot (-1/5) = -1$ $\mathbf{x} = \mathbf{1}/\mathbf{10}$

y + 3z = 1y + 3(-1/5) = 1-1 + 3/5

 $\mathbf{y}=\mathbf{8/5}$

Mudança B ightarrow A(b2)

4 x+y+5 z=12 x=y+3 z=5

y+3 z=2

4 x+y+5 z=12 x-y+3 z=5

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

6 x + 8 x = 62 x+6 z=7(-3)

-10 z = -15

z=3/2

2 x+**6** \cdot (3/2) = 7 $\mathbf{x} = -1$

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

Mudança B $\rightarrow A(b3)$

4x + y + 5z = 1

2x - y + 3z = 0y + 3z = 1

4x + y = 5z = 12x - y + 3z = 0

2x - y + 3z = 0

y + 3z = 16x + 8z = 1

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

 $\mathbf{z} = \mathbf{1}/\mathbf{5}$

y + 3(1/5) = 1

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

Mudança $\mathbf{A} \to B(a1)$

 $\mathbf{x.} \ \mathbf{b}_1 + y.b_2 + z.b_3 = a_1$

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

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

 $\begin{aligned}
 x + y + z &= 4(.2) \\
 -2x + 5y &= 2
 \end{aligned}$

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 $\mathbf{y} = -\mathbf{4}$

-2x + 5(-4) = 2-20

-2x = 2-2x = 22

 $\mathbf{x} = -11$

7y + 2z = 10 $7 \cdot (-4) + 2z = 10$ z = 19

Mudança $\mathbf{A} \to B(a2)$

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

 $\mathbf{x} + \mathbf{y} + \mathbf{z} = \mathbf{1} \cdot (2)$ -2x + 5y = -1

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

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

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

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

-2x + 0 = -1
-2x + 0 = -1

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

Mudança $\mathbf{A} \to B(a3)$

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 = 13y = -2

7y + 2z = 13y = -2

 $7 \cdot (-2) = 2z = 13$ z = 27/2

-2x + 5(-2) = 3

	$\frac{1}{10}$	-1	$\frac{-1}{10}$	「 1 ⁻		$\int \frac{1}{10} {}_{*}1$	-1_*3	$\frac{-1}{10}*(-1)$		$\begin{bmatrix} \frac{-25}{2} \end{bmatrix}$]
$\mathbf{M_B} o_{\mathbf{A}}$:	<u>8</u> 5	$\frac{-5}{2}$	$\frac{2}{5}$	3	\rightarrow	$\frac{8}{5}*1$	$\frac{-5}{2}$ *3	$\frac{2}{5}*(-1)$	=	-4	
$\mathbf{M_B} ightarrow_{\mathbf{A}}$:	$\frac{-1}{5}$	$\frac{3}{2}$	$\frac{1}{5}$	-1		$\frac{-1}{5}$ *!	$\frac{3}{2}*3$	$\frac{1}{5}*(-1)$	-	$\frac{55}{2}$	

		$\frac{1}{2}$	$\frac{-13}{2}$		0		-11*0	$\frac{1}{2} * 1$	$\frac{-13}{2}$ *2		$\left[\begin{array}{c} -14 \\ \overline{5} \end{array}\right]$	
$\mathbf{M}_A o_B$:	4	0	-2		1	\rightarrow	4_*0	0*1	-2*2	=	$\frac{-63}{10}$	
$\mathbf{M}_A o_B$:	19	$\frac{1}{2}$	$\frac{27}{2}$		2		19*0	$\frac{1}{2} * 1$	$\frac{27}{2} * 2$		$\frac{41}{10}$	
	L		_]	L _		L		_		L	

, 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.

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),(1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1
$\text{Início} \begin{bmatrix} -1 & 1 & 2 & 1 & 2 & 1 & 3 & & a \\ 1 & 0 & 2 & 0 & 0 & -1 & 0 & & b \\ 1 & -1 & 1 & 0 & 2 & -1 & 2 & & c \\ 1 & 1 & 1 & 1 & 0 & -1 & 0 & & d \\ 0 & 1 & -1 & 2 & 2 & -1 & 2 & & e \\ 1 & -1 & 1 & 1 & 0 & -1 & -1 & & f \\ 1 & 0 & 1 & 1 & 2 & 1 & 2 & & g \end{bmatrix}$
$l2 \rightarrow l2 + l1 \begin{bmatrix} -1 & 1 & 2 & 1 & 2 & 1 & 3 & a \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 1 & -1 & 1 & 0 & 2 & -1 & 2 & c \\ 1 & 1 & 1 & 1 & 0 & -1 & 0 & d \\ 0 & 1 & -1 & 2 & 2 & -1 & 2 & e \\ 1 & -1 & 1 & 1 & 0 & -1 & -1 & f \\ 1 & 0 & 1 & 1 & 2 & 1 & 2 & g \end{bmatrix}$
$13 \rightarrow l3 + l1 \begin{bmatrix} -1 & 1 & 2 & 1 & 2 & 1 & 3 & & a \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & & b+a \\ 0 & 0 & 3 & 1 & 4 & 0 & 5 & & c+a \\ 1 & 1 & 1 & 1 & 0 & -1 & 0 & & d \\ 0 & 1 & -1 & 2 & 2 & -1 & 2 & & e \\ 1 & -1 & 1 & 1 & 0 & -1 & -1 & & f \\ 1 & 0 & 1 & 1 & 2 & 1 & 2 & & g \end{bmatrix}$ $l4 \rightarrow l4 + l1$ $\begin{bmatrix} -1 & 1 & 2 & 1 & 2 & 1 & 3 & & a \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & & b+a \\ 0 & 0 & 3 & 1 & 4 & 0 & 5 & & c+a \\ 0 & 2 & 3 & 2 & 2 & 0 & 3 & & d+a \\ 0 & 1 & -1 & 2 & 2 & -1 & 2 & & e \\ 1 & -1 & 1 & 1 & 0 & -1 & -1 & & f \\ 1 & 0 & 1 & 1 & 2 & 1 & 2 & & g \end{bmatrix}$
$ l6 \rightarrow l6 + l1 \begin{bmatrix} -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{bmatrix} l7 \rightarrow l7 + l1 \begin{bmatrix} -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 & 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{bmatrix} $
$l1 \rightarrow l1 - l2 \begin{bmatrix} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 3 & 1 & 4 & 0 & 5 & c+a \\ 0 & 2 & 3 & 2 & 2 & 0 & 3 & d+a \\ 0 & 1 & -1 & 2 & 2 & -1 & 2 & e \\ 0 & 0 & 3 & 2 & 2 & 0 & 2 & f+a \\ 0 & 1 & 3 & 2 & 4 & 2 & 5 & g+a \end{bmatrix} l4 \rightarrow l4/2 \begin{bmatrix} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 3 & 1 & 4 & 0 & 5 & c+a \\ 0 & 1 & 3/2 & 0 & 0 & 0 & 3/2 & d+a/2 \\ 0 & 1 & -1 & 2 & 2 & -1 & 2 & e \\ 0 & 0 & 3 & 2 & 2 & 0 & 2 & f+a \\ 0 & 1 & 3 & 2 & 4 & 2 & 5 & g+a \end{bmatrix}$
$l4 \rightarrow l4 - l2 \begin{bmatrix} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 3 & 1 & 4 & 0 & 5 & c+a \\ 0 & 0 & -5/2 & 0 & -1 & 0 & -3/2 & d+3a-2b/2 \\ 0 & 1 & -1 & 2 & 2 & -1 & 2 & e \\ 0 & 0 & 3 & 2 & 2 & 0 & 2 & f+a \\ 0 & 1 & 3 & 2 & 4 & 2 & 5 & g+a \end{bmatrix} \\ l5 \rightarrow l5 - l2 \begin{bmatrix} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 3 & 1 & 4 & 0 & 5 & c+a \\ 0 & 0 & -5/2 & 0 & -1 & 0 & -3/2 & d+3a-2b/2 \\ 0 & 0 & -5 & 1 & 0 & -1 & -1 & e-b+a \\ 0 & 0 & 3 & 2 & 2 & 0 & 2 & f+a \\ 0 & 1 & 3 & 2 & 4 & 2 & 5 & g+a \end{bmatrix}$
$l7 \rightarrow l7 - l2 \begin{bmatrix} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 3 & 1 & 4 & 0 & 5 & c+a \\ 0 & 0 & -5/2 & 0 & -1 & 0 & -3/2 & d+3a-2b/2 \\ 0 & 0 & -5 & 1 & 0 & -1 & -1 & e-b+a \\ 0 & 0 & 3 & 2 & 2 & 0 & 2 & f+a \\ 0 & 0 & -1 & 1 & 2 & 2 & 2 & g+2a-b \end{bmatrix} \\ l3 \rightarrow l3/3 \begin{bmatrix} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 & c+a/3 \\ 0 & 0 & -5/2 & 0 & -1 & 0 & -3/2 & d+3a-2b/5 \\ 0 & 0 & -5/2 & 0 & -1 & 0 & -3/2 & d+3a-2b/5 \\ 0 & 0 & 3 & 2 & 2 & 0 & 2 & f+a \\ 0 & 0 & 3 & 2 & 2 & 0 & 2 & f+a \\ 0 & 0 & -1 & 1 & 2 & 2 & 2 & g+2a-b \end{bmatrix}$
$l4 \rightarrow -2.5.l4 \begin{bmatrix} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 & c+a/3 \\ 0 & 0 & 1 & 0 & 2/5 & 0 & 3/5 & -d+3a-2b/5 \\ 0 & 0 & -5 & 1 & 0 & -1 & -1 & e-b+a/5 \\ 0 & 0 & 3 & 2 & 2 & 0 & 2 & f+a \\ 0 & 0 & -1 & 1 & 2 & 2 & 2 & g+2a-b \end{bmatrix} \\ l5 \rightarrow l5/5 \begin{bmatrix} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 & c+a/3 \\ 0 & 0 & 1 & 0 & 2/5 & 0 & 3/5 & -d+3a-2b/5 \\ 0 & 0 & -1 & 1/5 & 0 & -1/5 & -1/5 & e-b+a/5 \\ 0 & 0 & 3 & 2 & 2 & 0 & 2 & b+a/3 \\ 0 & 0 & -1 & 1 & 2 & 2 & 2 & g+2a-b \end{bmatrix}$
$l6 \rightarrow l6/3 \begin{bmatrix} -1 & 0 & -2 & 0 & 0 & 1 & 0 \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 \\ 0 & 0 & 1 & 0 & 2/5 & 0 & 3/5 \\ 0 & 0 & -1 & 1/5 & 0 & -1/5 & -1/5 \\ 0 & 0 & 1 & 2/3 & 2/3 & 0 & 2/3 \\ 0 & 0 & -1 & 1 & 2 & 2 & 2 \end{bmatrix} \begin{bmatrix} -1 & 0 & -2 & 0 & 0 & 1 & 0 \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 \\ 0 & 0 & 0 & -1/3 & -14/15 & 0 & 16/15 \\ 0 & 0 & 1 & 2/3 & 2/3 & 0 & 2/3 \\ 0 & 0 & -1 & 1 & 2 & 2 & 2 \end{bmatrix} \\ l4 \rightarrow l4 - l3 \begin{bmatrix} -1 & 0 & -2 & 0 & 0 & 1 & 0 \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 \\ 0 & 0 & 0 & -1/3 & -14/15 & 0 & 16/15 \\ 0 & 0 & -1 & 1/5 & 0 & -1/5 & -1/5 \\ 0 & 0 & 1 & 2/3 & 2/3 & 0 & 2/3 \\ 0 & 0 & -1 & 1 & 2 & 2 & 2 \end{bmatrix} \\ = b + a/3 \\ 0 & 0 & -1 & 1 & 2 & 2 & 2 \end{bmatrix}$
$l5 \rightarrow l5 + l3 \begin{bmatrix} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 & c+a/3 \\ 0 & 0 & 0 & -1/3 & -14/15 & 0 & 16/15 \\ 0 & 0 & 0 & 8/15 & 4/3 & -1/5 & 22/15 & \frac{8a+3e-3b+3c}{15} \\ 0 & 0 & 1 & 2/3 & 2/3 & 0 & 2/3 & f+a/3 \\ 0 & 0 & -1 & 1 & 2 & 2 & 2 & g+2a-b \end{bmatrix} \\ l6 \rightarrow l6 - l3 \begin{bmatrix} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 & c+a/3 \\ 0 & 0 & 0 & -1/3 & -14/15 & 0 & 16/15 & \frac{-3d-14a+6b-3c}{15} \\ 0 & 0 & 0 & 8/15 & 4/3 & -1/5 & 22/15 & \frac{8a+3e-3b+3c}{15} \\ 0 & 0 & 0 & 1/3 & -2/3 & 0 & -1 & f-c/3 \\ 0 & 0 & -1 & 1 & 2 & 2 & 2 & g+2a-b \end{bmatrix}$
$l7 \rightarrow l7 + l3 \begin{bmatrix} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 & c+a/3 \\ 0 & 0 & 0 & -1/3 & -14/15 & 0 & 16/15 & \frac{-3d-14a+6b-3c}{15} \\ 0 & 0 & 0 & 8/15 & 4/3 & -1/5 & 22/15 & \frac{8a+3e-3b+3c}{15} \\ 0 & 0 & 0 & 1/3 & -2/3 & 0 & -1 & \frac{5c/3}{3} \\ 0 & 0 & 0 & 4/3 & 10/3 & 2 & 11/3 & \frac{3g+7a-3b+c}{3} \end{bmatrix} \\ l4 \rightarrow 3.l4 \begin{bmatrix} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 & c+a/3 \\ 0 & 0 & 0 & 1 & 14/5 & 0 & 16/5 & \frac{-3d-14a+6b-3c}{3} \\ 0 & 0 & 0 & 8/15 & 4/3 & -1/5 & 22/15 & \frac{8a+3e-3b+3c}{15} \\ 0 & 0 & 0 & 1/3 & -2/3 & 0 & -1 & \frac{5c-3b+3c}{15} \\ 0 & 0 & 0 & 4/3 & 10/3 & 2 & 11/3 & \frac{3g+7a-3b+c}{3} \end{bmatrix}$
$l5 \rightarrow 15/8.l5 \begin{bmatrix} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 & c+a/3 \\ 0 & 0 & 0 & 1 & 14/5 & 0 & 16/5 & \frac{-3d-14a+6b-3c}{8} \\ 0 & 0 & 0 & 1 & 5/2 & -3/8 & 11/4 \\ 0 & 0 & 0 & 1/3 & -2/3 & 0 & -1 & f-c/3 \\ 0 & 0 & 0 & 4/3 & 10/3 & 2 & 11/3 & \frac{3g+7a-3b+c}{3} \end{bmatrix} \\ l6 \rightarrow 3.l6 \begin{bmatrix} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 & c+a/3 \\ 0 & 0 & 0 & 1 & 14/5 & 0 & 16/5 & \frac{-3d-14a+6b-3c}{8} \\ 0 & 0 & 0 & 1 & 14/5 & 0 & 16/5 & \frac{-3d-14a+6b-3c}{8} \\ 0 & 0 & 0 & 1 & 5/2 & -3/8 & 11/4 & \frac{8a+3e-3b+3c}{8} \\ 0 & 0 & 0 & 1 & 5/2 & -3/8 & 11/4 & \frac{8a+3e-3b+3c}{8} \\ 0 & 0 & 0 & 1 & -2 & 0 & -3 & f-c \\ 0 & 0 & 0 & 4/3 & 10/3 & 2 & 11/3 & \frac{3g+7a-3b+c}{3} \end{bmatrix}$
$l5 \rightarrow l5 - l4 \begin{bmatrix} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 & c+a/3 \\ 0 & 0 & 0 & 1 & 14/5 & 0 & 16/5 & \frac{-3d-14a+6b-}{5} \\ 0 & 0 & 0 & 0 & -3/10 & -3/8 & -9/20 \\ 0 & 0 & 0 & 1 & 5/2 & 3/2 & 11/4 \end{bmatrix} \xrightarrow{\frac{3g+7a-3b+c}{4}} \\ \begin{bmatrix} -1 & 0 & -2 & 0 & 0 & 1 & 0 & 2a+b \\ 0 & 1 & 4 & 1 & 2 & 0 & 3 & b+a \\ 0 & 0 & 1 & 1/3 & 4/3 & 0 & 5/3 & c+a/3 \\ 0 & 0 & 0 & 1 & 14/5 & 0 & 16/5 & \frac{-3d-14a+6b-}{5} \\ 0 & 0 & 0 & 1 & 14/5 & 0 & 16/5 & \frac{-3d-14a+6b-}{5} \\ 0 & 0 & 0 & 0 & -3/10 & -3/8 & -9/20 & \frac{-72a+13e-+55b+15c-24d}{40} \\ 0 & 0 & 0 & 0 & -24/5 & 0 & -31/5 & f-c \\ 0 & 0 & 0 & 1 & 5/2 & 3/2 & 11/4 & \frac{3g+7a-3b+c}{4} \end{bmatrix}$

$13 \rightarrow l3 - ($	$11 \rightarrow l1 - l$	$12 \rightarrow l2 - ($	$l4 \rightarrow l4 - (16)$	l6 ightarrow l6 - (1/6)	l7 ightarrow l7 - l6	l6 ightarrow -4/5.l6	l6 o l6 - l5	$l6 \rightarrow -5/24.l6$	l7 o l7 - l4
(4/3.l5)	0	(3.17)	/5.17)		0 0 0 0 0	0 0 0 0 0			
0 0 0 0 0	1 4 0 1 0 0 0 0 0 0 0 0	-1 0 0 0 0 0 0 0 0 0 0	0 1	-1 0 0 0 0 0 0 0 0 0 0 0	0 1 0 0 0 0 0 0	0 -2 1 4 0 1 0 0 0 0 0 0 0 0	0 1 0 0 0 0 0 0	0 1 0 0 0 0	0 1 0 0 0 0
1 4 0 1 0 0 0 0 0 0 0 0	1 1/3 1/3 1 0 0 0 0 0	4 1 1 0 0 0	0 0	4 1 1 0 0	1/3 4 1 1 0	0 1 1/3 1 0 0	,	1/3 1 0 0	1 1 0 0
1 2 1/3 0 1 0 0 1 0 0	4/3 14/5 1 0	0 0 1 2 /3 4/3 1 14/ 0 1 0 0 0 0	1 2 1/3 4/ 1 14, 0 1 0 0	0 0 1 2 /3 4/3 1 14/3 0 1 0 0		0	0 1 2 0 4/3 0 4/5 0 1 5/ 0 -5/	0 2 4/3 14/5 1 1 -3/10	2 4/3 4/5 3/10 -3 24/5
0 0 0 0 0 0 0 0 1 0 0 1	0 0 0 0	0 0 0 0 0 0 0 0 0 0	3 0 /5 0 5/4	0 0 5 0 $5/4$	4 3/2 1/6	0 5 0 5 0 16 5/4 3 1 1	3 5/3 16/5 4 3/2 4 -5/2	0 0 5 0 10 5/4 3 0 31	1 0 0 3 0 5/3 0 16/ 8/8 -9/2 0 -31/ /2 -9/2
$\begin{array}{ c c c c c }\hline & 360e + 8 \\ \hline & 260g + 62 \\ \hline & 16g - 1 \\ \hline & 60e - 10 \\ \hline & & \\ \hline \end{array}$	$\frac{360e + 838}{120e - 15}$ $\frac{120e - 15}{920e - 3525}$ $\frac{60e - 106}{920e - 106}$	0 1920 0 1920 0 595	3 5/3 0 1	0 3 5/3 16/5 3/2 0 1 -	 -	/2 - = /6 - -	5 - = 4 -20c+	/24 -	$\begin{vmatrix} & & & & & & & & & & & \\ & & & & & & & $
35b - 1214a - 60e - 605c - 226 - 60e - 302d + 6061a + 685b - 606	$ \frac{12a+5e+3}{2} $ $ \frac{5b-1214a-3}{2} $ $ \frac{25c-417a+2}{1} $ $ \frac{d-3402a+4}{1} $ $ \frac{1a+685b-3}{5} $ $ \frac{10g-5e-5}{2} $ $ \frac{22a+270b-3}{5} $	60e + 835b - 1 $120e - 125c - 2$ $120e - 125c - 3$ $120e - 125e - 4$ $120e - 422a + 3$	920e - 3525e $595e - 1932e$ $-120e - 42$	<u>-2</u>		$2a+b$ $b+a$ $\frac{c+a}{3}$ $\cdot \frac{-3d-14a-5}{5}$ $-24a+5e+1$ $\frac{4c+6e-f-9}{6}$ $38a+5e-10$	$2a+b$ $b+a$ $\frac{c+a}{3}$ $-\frac{-3d-14a-}{5}$ $-\frac{-24a+5e+1}{4}$ $\frac{-30e-5f-4e}{24}$ $\frac{5g+7a+3b}{2}$	$2a+b$ $b+a$ $\frac{c+a}{3}$ $-\frac{-3d-14a}{5}$ $\frac{-24a+5e+11}{4}$ $\frac{5f-10c-3d}{24}$ $\frac{g-21a+9b-20}{20}$	$ \begin{array}{c} 2a+b \\ b+a \\ \frac{c+a}{3} \\ -3d-14a+6 \\ 5 \\ +15e+33b-40 \\ -10c-3d-1 \\ 5 \\ -21a+9b-1 \\ 20 \end{array} $
$ \begin{array}{r} 237a + 1370b \\ 75 \\ +161a - 25b + \\ \hline 5 \\ -315c + 575d \\ \hline 5 \\ -5c + 38a - 5 \\ \hline 25 \\ \end{array} $	$\begin{array}{c} 390c - 675d + \\ 270b - 255d + \\ 15 \\ 170b - 1955c \\ 25 \\ 15c + 575d + \\ 50 \\ 5c + 38a - 5b \\ 25 \\ \end{array}$	$\begin{array}{c} 417a + 270b \\ \hline 15 \\ \hline 402a + 4170b \\ \hline 125 \\ \hline 345b - 655c + \\ \hline 50 \\ \hline g - 5e - 5c + 3 \\ \hline 25 \\ \hline \end{array}$	b- <u>c-</u> : : : : : : : : : : : : :	$ \begin{array}{r} 2a+b \\ b+a \\ \frac{c+a}{3} \\ -3d-14a+ \\ 5 \\ 4a+5e+11b \\ 4 \\ 4g-5e-5c+5 \\ 25 \\ +270b-130c \\ 25 \end{array} $	$ \frac{4a+6b-5c}{5} \\ +11b-5c-8c \\ 4 \\ -9d-26a+1c \\ 6 $	$\frac{+6b-5c}{1b-5c-8d}$ d-26a+12b	$\frac{+6b-5c}{1b-5c-8d}$ $\frac{5d-130a+60}{1}$	+6b-5c $1b-5c-8d$ $-14a+6b$	$\frac{15c - 24d}{4a + 6b}$
d+180g-7 $d-1275d-1$ $d+10c-16f$ $d+155g-75$ $d+155g-75$	-180g - 75j $-60g - 25f$ $c + 960g - 4$ $155g - 75f$	-675d+18 $-255d+60$ $-1955c+9$ $+1150d+30$ $38a-5b$	25 55c+1150a 50 6c+38a-56 25	-6b - 5c $-5c - 8d$ $38a - 5b$	12b			l7 ightarrow -	l o -
125 <u>f</u> l'	00f l4	0g - 25f $960g - 400$ $60g - 150f$	<u>d</u> +360 <i>g</i> −1	$0g{-}25f$		-4/25.6	ightarrow 17 - l!	-10/3.l7	-10/3.l4
2 o l2	t o l4 -	f l5	50 <u>f</u>	l o t	-6.17	$\begin{bmatrix} -1 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$	$\begin{bmatrix} -1 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$	$\begin{bmatrix} -1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0$	0 0 0 0
- (2. <i>l</i> 5)	- (14/5	ightarrow l5 $-$	l3 o l3	d5 - (3/6)		0 (0 -2 1 4 0 1 0 0 0 0 0 0 0 0	0 -2 1 4 0 1 0 0 0 0 0 0 0 0	1 4 0 1 0 0 0 0 0
	(i.15)	(5/4.16	3 – (5/3		0 0	2 0 4 1 1 1/3 0 1 0 0 0 0	1 1/3 1 0	0 1 1/3 1 0 0	1 0 0
 4 1 0 0 0 	0 1		3.17)	-1 0 0 0 0 0 0 0 0 0 0	1/3	0 2 $3 - 4/3$ $14/5$ 1 0	0 2 $4/3$ $14/5$ 1 0	0 2 4/3 14/5 1 1	0 2 $4/3$ $14/5$ 1 $-24/5$ $-3/10$
1 1/3 1 0	4 1 1 1/ 0 1 0 0 0 0	0 1	-1 0 0 1 0 0 0 0 0 0 0 0	4 1 1 0 0 0	4/3 14/5 1 5		$ \begin{array}{c} 1 \\ 0 \\ 0 \\ \hline 5/4 \\ -5/4 \\ -25/4 \end{array} $	1 0 0 0 5/4 0 -5	$ \begin{array}{c} 1 \\ 0 \\ 0 \\ \hline 0 \\ 5/4 \\ 0 \\ \hline 3/2 \\ \end{array} $
0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0	2 3 4/3 0 1 0		-2 0 4 1 1 1/3 0 1 0 0 0 0 0 0	1 14, 0 1 0 0	0 5/ 0 16, 5/4 3/ 1 1/	0 3 5/3 16/5 3/2 1/6 0	0 3 5/3 16/5 3/2 -5/24		-31/5
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	0 0 0 0 0 0 0 0 1 0 0 1	2 0 4/3 0 14/5 0 1 0 0 1	2 3 4/3 14/5 1 0	0 $3 0$ $\sqrt{5} 0$ $5/4$ 1	 	$-\frac{-24a}{-4c+6e}$	- = = = = = = = = = = = = = = = = = = =	-3d $-24a+5$ $-5f-10a$	$-\frac{-3d-}{2}$ $-\frac{-24a+5}{5f-10c-}$
4e+169b-2 $+620e-605$ $16g+60e-3$ $e-1061a+6$ $10g$	$\frac{360e + 835}{120e - 12}$ $\frac{16g + 60}{60e - 106}$	0	1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		_ <u>-34a</u> _ <u>-4c+6</u>	$ \begin{array}{c} 2a+b \\ b+a \\ \frac{c+a}{3} \\ \frac{d-14a+6b-5}{4} \\ \frac{c+f-9d-26}{6} \\ +5e-10g+5 \\ 4 \end{array} $	$ 2a+b $ $ b+a $ $ \frac{c+a}{3} $ $ -3d-14a+5e+11 $ $ 4 $ $ 30e-5f-45 $ $ 24 $ $ 8a+5e-100 $ $ 4 $	$\begin{array}{c} 2a + b \\ b + a \\ \frac{c + a}{3} \\ \frac{-14a + 6b - 5}{5} \\ \frac{-14a + 6b - 5}{4} \\ \frac{-3d - 14a + 24}{24} \\ \frac{a + 3b - 5c - 4}{2} \end{array}$	a+b $b+a$ $c+a$ 3 $14a+6b-5a$ 5 $e+11b-5c-4$ 4 $-3d-14a+6$ 5 $+9b-15c-1$ 20
$\frac{c-2237a+1}{75}$ $\frac{02d+161a-}{5}$ $\frac{85b-315c+3}{50}$ $\frac{c-5e-5c+38}{25}$	$ \frac{5c - 417a + 2}{1} $ $ \frac{5c - 302d + 16}{5} $ $ \frac{1a + 685b - 31}{5} $ $ \frac{10g - 5e - 5}{2} $	120e-125d- 20e-3525d- 60e-1061a	$\begin{vmatrix} & & & & & & & & & & & & & & & & & & &$		$ \begin{array}{c} 2a+b \\ b+a \\ \frac{c+a}{3} \\ \frac{d-14a+6b-5}{5} \\ +5e+11b-5 \\ 4 \\ e-f-9d-26 \\ 6 \\ 0b-130c-22 \\ 25 \end{array} $	$\frac{c-8d}{6a+12b}$	$\frac{b-5c-8d}{d-130a+60}$	<u>-8d</u> - <u>6b</u>	<u>-8d</u> <u>ib</u>
35d+32g-15 $370b-1275d-1275d-125b+10c-16$ $575d+155g-125$	90c - 675d + 1 5 $70b - 255d + 6$ 5 $61a - 25b + 106$ 6 $5c + 575d + 18$ 6	$ \begin{array}{r} 25 \\ c-417a+270 \\ \hline 15 \\ -3402a+4170 \\ \hline 125 \\ c+685b-315c \\ 50 \\ \hline 10g-5e-5c+25 \\ 25 \end{array} $	3525d - 3402a $1932a + 1345a$ $10g - 5a$	$\frac{10g - 5e - 5}{2}$	<u>c-8d</u>		$b \over b$		
-125 <i>f f</i> 75 <i>f</i>	0g - 25f $c - 16f$ $65g - 75f$	c - 675d + 180g b - 255d + 60g b - 1955c + 96 + 575d + 155g	125	$-a$ $\frac{a}{5}$ $\frac{a+6b-5c}{5}$ $\frac{5c+1150d+3c}{6}$					
		-25f $0g-400f$ $-75f$	65c + 960g - 40 $6d + 360g - 150$ $6b$						

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

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

	1	0	0	0	0	0	0	$-\frac{330g+655e-6048a+3080b-1295c+470d-90f}{75}\\ -\frac{480g-1070e-3070b+5883a+1330c+1565d+195f}{75}$
	0	1						$\frac{-480g - 1070e - 3070b + 5883a + 1330c + 1565d + 195f}{75}$
	0	0	1	0	0	0	0	$\frac{180g + 320e - 655c - 3042a + 1495b + 235d - 45f}{75}$
$l1 \rightarrow -1.l1$	0	0	0	1	0	0	0 0	$\tfrac{16g + 60e - 302d + 161a - 25b + 10c - 16f}{5}$
	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	$-\frac{120e-422a+270b-130c-225d+60g-25f}{25}$

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; $\frac{19}{5}$