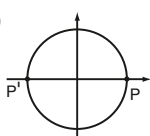


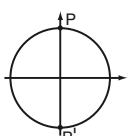
C: $13\pi, -21\pi$ e -7π .

D: $-\frac{5\pi}{2}, \frac{7\pi}{2}$ e $-\frac{25\pi}{2}$.

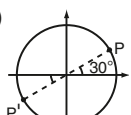
3. a)



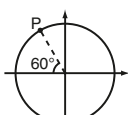
d)



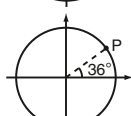
b)



e)



c)



4. a) Hexágono.

b) Perímetro: 6 u.c.; Área: $\frac{3\sqrt{3}}{2}$ u.a.

5. a) Negativo.

d) Positivo.

b) Positivo.

e) Negativo.

c) Negativo.

f) Positivo.

6. a) 0

c) $\frac{\sqrt{3}}{2}$

e) $-\frac{\sqrt{3}}{2}$

b) 1

d) $-\frac{1}{2}$

f) $-\frac{\sqrt{2}}{2}$

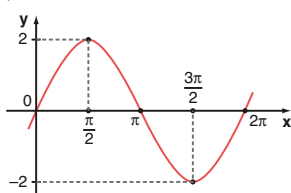
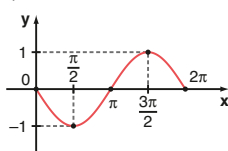
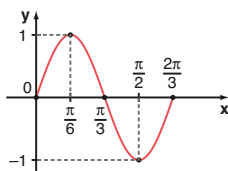
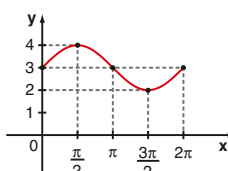
7. a) V

c) F

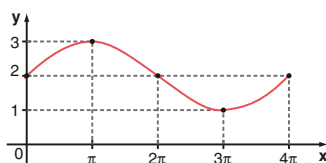
e) F

b) V

d) V

8. a) $p = 2\pi$; $\text{Im} = [-2, 2]$.b) $p = 2\pi$; $\text{Im} = [-1, 1]$.c) $p = \frac{2\pi}{3}$; $\text{Im} = [-1, 1]$.d) $p = 2\pi$; $\text{Im} = [2, 4]$.

e) $p = 4\pi$; $\text{Im} = [1, 3]$.



9. $\{t \in \mathbb{R} \mid -3 \leq t \leq 1\}$

10. $\left\{m \in \mathbb{R} \mid \frac{3}{2} \leq m \leq 2\right\}$

11. a) $\frac{\pi}{2}$

b) 5

12. a) 6 m

d) 24 s

b) 8,8 m

e) 11 voltas.

c) 2 m

13. a) -1

c) 0

e) $-\frac{1}{2}$

b) 1

d) 0

f) -1

14. a) $-\frac{1}{2}$

d) $-\frac{1}{2}$

b) $\frac{\sqrt{2}}{2}$

e) 0

c) $-\frac{\sqrt{3}}{2}$

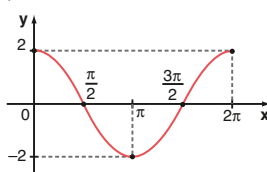
f) $-\frac{\sqrt{2}}{2}$

15. $y = -\frac{\sqrt{2}}{4}$

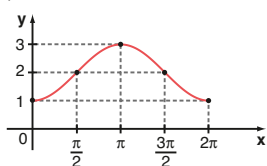
16. $\left\{m \in \mathbb{R} \mid -\frac{5}{2} \leq m \leq 0\right\}$

17. 0

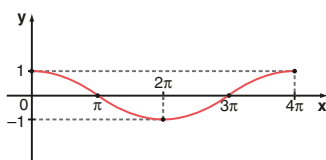
18. a) $p = 2\pi$; $\text{Im} = [-2, 2]$.



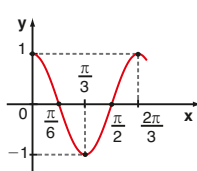
b) $p = 2\pi$; $\text{Im} = [1, 3]$.



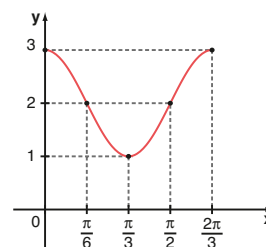
c) $p = 4\pi$; $\text{Im} = [-1, 1]$.



d) $p = \frac{2\pi}{3}$; $\text{Im} = [-1, 1]$.



e) $p = \frac{2\pi}{3}$; $\text{Im} = [1, 3]$.



19. a) F; $\cos\left(\frac{\pi}{6} + k2\pi\right) = \cos \frac{\pi}{6} = \frac{\sqrt{3}}{2}$

b) V

c) F; o valor mínimo é -2.

d) F; f é uma função afim.

e) V

f) V

20. a) 2020: 418 milhões (US\$);

2025: 409 milhões (US\$);

2030: 391 milhões (US\$).

b) 3 vezes; 382 milhões (US\$).

21. a) $D = \mathbb{R}$; $\text{Im} = [-1, 1]$; $p = \frac{2\pi}{3}$.

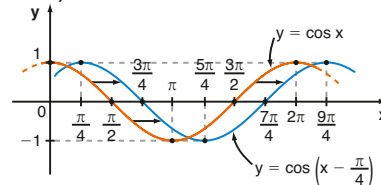
b) $D = \mathbb{R}$; $\text{Im} = [-3, 3]$; $p = 2\pi$.

c) $D = \mathbb{R}$; $\text{Im} = [-3, 1]$; $p = 4\pi$.

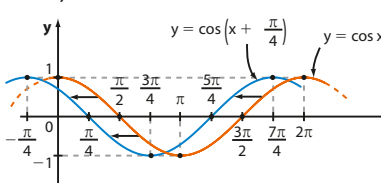
d) $D = \mathbb{R}$; $\text{Im} = \mathbb{R}$; f não é periódica.

e) $D = \mathbb{R}$; $\text{Im} = [-4, 4]$; $p = \frac{\pi}{3}$.

22. a)



b)



23. Alternativa b.

Desafio

1

CAPÍTULO
5

Matrizes

Exercícios

1. a) 3×2

c) 2×2

e) 3×1

b) 1×4

d) 3×3

f) 3×4

2. a) 4

b) 3

c) 1

d) 1

3. $A = \begin{bmatrix} 1 & -1 \\ 4 & 2 \end{bmatrix}$

4. $B = \begin{bmatrix} 4 & 5 \\ 5 & 6 \\ 6 & 7 \end{bmatrix}$
5. 0
6. a) $A^t = \begin{bmatrix} 7 & 1 \\ -4 & 0 \end{bmatrix}$
 b) $B^t = \begin{bmatrix} 6 & 1 & 4 \\ 2 & 0 & -1 \end{bmatrix}$
 c) $C^t = \begin{bmatrix} 0 & 0 \\ 3 & -1 \\ -9 & 5 \end{bmatrix}$
 d) $D^t = \begin{pmatrix} -8 \\ 7 \\ 5 \end{pmatrix}$
 e) $E^t = \begin{pmatrix} 0 & 1 & 0,5 & 3 \\ -2 & 11 & 7 & 4,1 \end{pmatrix}$
 f) $F^t = [5 \ 7 \ 1 \ 0 \ 3]$
 g) $G^t = \begin{bmatrix} 2 & -3 & 3 \\ 1 & 1 & -1 \\ -2 & 2 & 2 \end{bmatrix}$
7. $A^t = \begin{bmatrix} 5 & 7 & 9 \\ 8 & 10 & 12 \end{bmatrix}$
8. 3
9. Principal: 1, 4 e 9.
 Secundária: 3, 4 e 3.
10. a) 1485 c) R\$ 27 135,00
 b) 190
11. a) X e Y: 15 km
 Z e X: 27 km
 Y e Z: 46 km
 b) $D^t = D$
12. $A = \begin{pmatrix} 0 & 1 & 1 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}$
13. a) $A = \begin{bmatrix} -1 & 0 \\ 1 & 1 \\ -1 & -1 \end{bmatrix}$
 b) $A^t = \begin{bmatrix} -1 & 1 & -1 \\ 0 & 1 & -1 \end{bmatrix}$
14. a) Canadá 0×1 México
 b) Argentina; 3 pontos.
15. a) $m = 3$ e $n = 4$.
 b) $q_{23} = 875$; em 100 g de queijo mozzarella há 875 mg de cálcio.
 $q_{31} = 35,6$; em 100 g de queijo parmesão há 35,6 g de proteínas.
 c) 9360 mg
 d) Mais que a metade.
16. a) Traço de A = -6
 Traço de B = 9
 Traço de C = 36
 b) $\theta = \frac{\pi}{6}$ ou $\theta = \frac{5\pi}{6}$.
17. $a = 2$, $b = 1$, $c = 6$ e $d = 4$.
18. $x = 4$, $y = 3$ e $z = 2$.
19. a) Não existe $m \in \mathbb{R}$.
 b) $m = -3$
20. $p = q = 3$
21. $a = -3$, $b = -2$, $c = -1$, $d = 0$, $e = 5$ e $f = 0$.
22. a) A e C.
 b) 3

23. a) $\begin{pmatrix} 11 & 5 \\ 14 & 12 \end{pmatrix}$ c) $(-5 \ -1 \ -8 \ -3)$
 b) $\begin{bmatrix} 11 & 16 \\ 2 & 7 \\ 1 & 5 \end{bmatrix}$ d) $\begin{bmatrix} 5 & -1 & 0 \\ 1 & 5 & -1 \\ 4 & 1 & 5 \end{bmatrix}$
24. a) 21; 27 b) $c_{ij} = 3i$
25. a) $X = \begin{pmatrix} 1 & -3 \\ 1 & 2 \\ 5 & 8 \end{pmatrix}$
 b) $X = \begin{pmatrix} 0 & 6 & 18 \\ -5 & 9 & -2 \end{pmatrix}$
 c) $X = \begin{pmatrix} 1 & 2 \\ 1 & 13 \end{pmatrix}$
26. a) $\begin{bmatrix} 3 & 3 & 0 & 5 & 5 \\ 1 & 1 & 3 & 4 & 2 \\ 8 & 5 & 5 & 4 & 5 \end{bmatrix}$
 b) C, C e A.
27. a) Sim; não.
 b) Não existe $m \in \mathbb{R}$ que satisfaz a condição.
28. $X = \begin{bmatrix} -3 & 3 \\ -1 & 6 \\ -1 & -1 \end{bmatrix}$
29. a) $\begin{pmatrix} 4 & 8 & 12 \\ -12 & 20 & -4 \end{pmatrix}$
 b) $\begin{pmatrix} \frac{1}{3} & \frac{2}{3} & 1 \\ -1 & \frac{5}{3} & -\frac{1}{3} \end{pmatrix}$
 c) $\begin{pmatrix} -2 & -4 & -6 \\ 6 & -10 & 2 \end{pmatrix}$
30. a) $\begin{pmatrix} 9 & 10 \\ 2 & 21 \\ 9 & 29 \end{pmatrix}$ c) $\begin{pmatrix} 13 & -1 & 27 \\ 2 & 28 & 38 \end{pmatrix}$
 b) $\begin{pmatrix} -7 & 10 \\ 4 & -13 \\ -27 & -17 \end{pmatrix}$
31. $\begin{pmatrix} 9 & -1 & 1 \\ 1 & 4 & 4 \end{pmatrix}$ 32. $\begin{pmatrix} 5 & 5 \\ 3 & 2 \end{pmatrix}$
33. $X = \begin{bmatrix} -3 & 1 \\ -1 & 2 \\ -4 & -1 \end{bmatrix}$
34. a) $\begin{bmatrix} -2 & 5 \\ -2 & 13 \end{bmatrix}$
 b) $\begin{bmatrix} 0 & 3 & 2 & 7 \\ -10 & 9 & 6 & -19 \end{bmatrix}$
 c) Não existe.
 d) $\begin{bmatrix} -2 \\ -4 \\ -6 \end{bmatrix}$
 e) $\begin{bmatrix} -15 & 10 \\ 0 & 17 \\ 4 & 3 \\ 8 & 6 \end{bmatrix}$

$$f) \begin{pmatrix} 12 & -4 & 16 \\ 18 & -6 & 24 \\ 30 & -10 & 40 \end{pmatrix}$$

g) Não existe.

$$h) \begin{pmatrix} 10 & -4 & 3 \\ 13 & -1 & 3 \\ 9 & 6 & 3 \end{pmatrix}$$

$$35. a) \begin{pmatrix} 11 & 4 \\ 4 & 2 \\ 10 & 3 \end{pmatrix} \quad d) \begin{pmatrix} 5 \\ 3 \end{pmatrix}$$

b) Não existe. e) $\begin{pmatrix} 5 & 4 & 2 \\ 6 & 6 & 1 \end{pmatrix}$

$$c) \begin{pmatrix} 1 \\ 8 \\ -8 \end{pmatrix}$$

36. a) 3 b) 17 c) Não existe.

37. 22

38. $x = 2$ e $y = -4$.

$$39. a) \begin{pmatrix} 7 & 10 \\ 15 & 22 \end{pmatrix} \quad b) \begin{pmatrix} 11 & 12 & 2 \\ 20 & 33 & 12 \\ 5 & 18 & 34 \end{pmatrix}$$

$$40. a) \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \quad d) \begin{pmatrix} 1 & 1 \\ 0 & -1 \end{pmatrix}$$

$$b) \begin{pmatrix} 1 & 1 \\ 0 & -1 \end{pmatrix} \quad e) \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$

$$c) \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$

41. $m = 3$

$$42. \begin{bmatrix} 4 & 6 & 7 \\ 9 & 3 & 2 \\ 7 & 8 & 10 \end{bmatrix} \cdot \begin{bmatrix} 7 \\ 6 \\ 5 \end{bmatrix} = \begin{bmatrix} 99 \\ 91 \\ 147 \end{bmatrix}$$

$A = 99 \quad B = 91 \quad C = 147$

$$43. \begin{pmatrix} -4 & 2 \\ -64 & 19 \end{pmatrix}$$

44. a) 24

$$b) \begin{bmatrix} 22 & 18 \\ 36 & 22 \\ 24 & 28 \end{bmatrix} \cdot \begin{bmatrix} 4,50 \\ 6,00 \end{bmatrix} = \begin{bmatrix} 207 \\ 294 \\ 276 \end{bmatrix}$$

$$45. x = \frac{15}{2} \text{ e } y = \frac{2}{5}.$$

$$46. x = \frac{3}{2} \text{ e } y = -\frac{3}{4}.$$

47. Resposta pessoal; qualquer matriz da

forma $\begin{pmatrix} x & y \\ -2y & x \end{pmatrix}$, com $x \in \mathbb{R}$ e $y \in \mathbb{R}$, serve como exemplo.

48. a) Bicarbonato: 23,8 kg;
 carbonato: 5 kg; ácido: 21,2 kg.

$$b) \begin{pmatrix} 2,3 & 2,5 \\ 0,5 & 0,5 \\ 2,2 & 2 \end{pmatrix} \cdot \begin{pmatrix} 6000 \\ 4000 \end{pmatrix}$$

c) 9 500 envelopes na versão T e 5 500 envelopes na versão E.

$$49. a) X = \begin{pmatrix} -3 \\ -1 \end{pmatrix} \quad b) X = \begin{pmatrix} -4 & -7 \\ 13 & 25 \end{pmatrix}$$

50. 1ª semana: R\$ 31,28

2ª semana: R\$ 29,85

51. a) $\begin{bmatrix} 346 & 297 & 553 \\ 130 & 197 & 167 \end{bmatrix}$

b) $c_{12} = 297$; 297 mg é a quantidade total de cálcio encontrada na receita II.c) $c_{23} = 167$; 167 mg é a quantidade total de magnésio encontrada na receita III.

52. Sim.

53. $\begin{pmatrix} 0 & 1 \\ \frac{1}{2} & -\frac{1}{2} \end{pmatrix}$

54. Não existe.

55. $x = 1$

56. a) $\begin{pmatrix} 1 & -1 \\ -4 & 7 \end{pmatrix}$

c) $\begin{pmatrix} \frac{11}{3} & \frac{7}{3} \\ 3 & 2 \end{pmatrix}$

b) $\begin{pmatrix} 6 & -7 \\ -9 & 11 \end{pmatrix}$

57. $x = 7$ e $y = 1$.58. $x = 1$

59. a) $A^{-1} = \begin{pmatrix} 2 & -3 \\ -3 & 5 \end{pmatrix}$

b) $X = \begin{pmatrix} -5 & -16 \\ 12 & 28 \end{pmatrix}$

60. $\begin{bmatrix} -\frac{1}{3} & 0 & \frac{2}{3} \\ 0 & \frac{1}{3} & 0 \\ \frac{2}{3} & 0 & -\frac{1}{3} \end{bmatrix}$

61. $X = \begin{pmatrix} \frac{3}{7} & -\frac{5}{7} \\ \frac{1}{7} & -\frac{4}{7} \end{pmatrix}$

► **Desafio**

a) $\left(x = 0, y = -\frac{\sqrt{2}}{2} \text{ e } z = \frac{\sqrt{2}}{2} \right)$ ou

$\left(x = 0, y = \frac{\sqrt{2}}{2} \text{ e } z = -\frac{\sqrt{2}}{2} \right)$.

b) Resposta pessoal; demonstração.

► **Exercícios**1. a, c, f, h .

2. a) Sim. c) Sim.

b) Não.

3. a) Sim. c) Não.

b) Não.

d) Sim.

4. -8

5. a) $80x + 120y = 25200$

b) Sim; não.

c) Não; sim.

6. $m = -\frac{15}{19}$

7. Entre outras, são soluções:

a) $\left(0, -\frac{5}{3} \right)$ ou $(-2, 1)$.

b) $(0, 1, 1)$ ou $(1, 1, 2)$.

c) $(0, 2)$ ou $(1, 1)$.

d) $\left(0, 0, \frac{16}{5} \right)$ ou $(2, 2, 2)$.

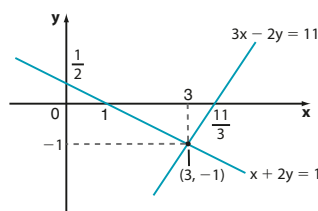
8. 8

9. a) 18

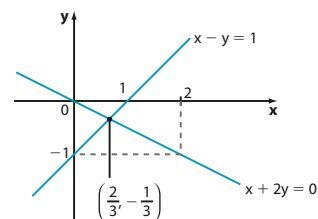
b) 10

10. a) $-4x + 3y = -1$, por exemplo.

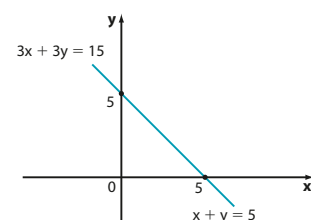
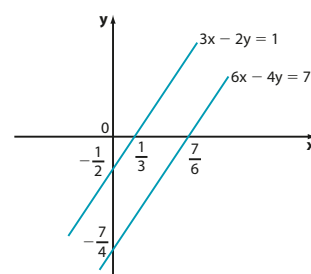
b) Resposta pessoal.

11. a) $S = \{(3, -1)\}$; S.P.D.

b) $S = \left\{ \left(\frac{2}{3}, -\frac{1}{3} \right) \right\}$; S.P.D.



c) $S = \{(x, 5 - x); x \in \mathbb{R}\}$ ou $S = \{(5 - y, y); y \in \mathbb{R}\}$; S.P.I.

d) $S = \emptyset$; S.I.

12. 30 unidades.

13. R\$ 28,40

14. R\$ 360,00

15. a) 51 pontos.

b) 11 erros.

c) Não é possível.

16. $m \neq \frac{5}{2}$

17. 11

18. $m = -4$ e $n = 2$.19. a) $(3, -2)$ é solução e $\left(-\frac{1}{3}, \frac{4}{3}\right)$ não é solução.

b) $\begin{pmatrix} 1 & 1 \\ 2 & 3 \end{pmatrix} \cdot \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 1 \\ 0 \end{pmatrix}$

20. b

21. a) $A = \begin{bmatrix} 1 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 1 \end{bmatrix}$ e $B = \begin{bmatrix} 1 & 1 & 0 & 7 \\ 1 & 0 & 1 & 8 \\ 0 & 1 & 1 & 9 \end{bmatrix}$

b) $A = \begin{bmatrix} 4 & -1 & 1 \\ 1 & 2 & -1 \\ 1 & 0 & -1 \end{bmatrix}$ e $B = \begin{bmatrix} 4 & -1 & 1 & -1 \\ 1 & 2 & -1 & -2 \\ 1 & 0 & -1 & -5 \end{bmatrix}$

c) $A = \begin{bmatrix} 3 & 2 \\ 1 & -1 \\ 4 & 1 \end{bmatrix}$ e $B = \begin{bmatrix} 3 & 2 & -4 \\ 1 & -1 & -7 \\ 4 & 1 & 2 \end{bmatrix}$

d) $A = \begin{bmatrix} 2 & 1 & 3 \\ -1 & 1 & 10 \end{bmatrix}$ e $B = \begin{bmatrix} 2 & 1 & 3 & -13 \\ -1 & 1 & 10 & 4 \end{bmatrix}$

22. a) $\begin{cases} 3x + 2y = 0 \\ 2x + 5y = 2 \end{cases}$

b) $\begin{cases} 5x + 7y - 2z = 11 \\ x - y + 3z = 13 \end{cases}$

c) $\begin{cases} x + y + z = 3 \\ 2x - 4y + 3z = 11 \\ -3x - 3y - 3z = 10 \end{cases}$

23. a) $m = 1$ c) $m = 3$ b) $m = 3$

24. a) $\begin{pmatrix} 1 & 2 & 1 \\ 2 & 3 & -1 \end{pmatrix} \cdot \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 5 \\ 0 \end{pmatrix}$

b) Verificação.

c) Verificação.

d) -25

25. a e c estão escalonados.26. a) $S = \{(-3, 7)\}$; S.P.D.b) $S = \{(3, 3, -4)\}$; S.P.D.c) $S = \{(7 + \alpha, 2 + 3\alpha, \alpha); \alpha \in \mathbb{R}\}$; S.P.I.d) $S = \{(6, 0, 3, 2)\}$; S.P.D.e) $S = \emptyset$; S.I.27. $\alpha = 3, \beta = 2, \gamma = -6$.28. a) $x - y = 8$

b) Resposta pessoal.

c) $S = \{(8 + \alpha, \alpha); \alpha \in \mathbb{R}\}$; S.P.I.29. $S = \{(1 + \alpha, -1 + 2\alpha, \alpha); \alpha \in \mathbb{R}\}$ 30. a) $S = \{(1, 3, 2)\}$; S.P.D.b) $S = \{(-11, -6, -3)\}$; S.P.D.c) $S = \emptyset$; S.I.

d) $S = \left\{ \left(\frac{-1 + \alpha}{2}, \frac{5 - 3\alpha}{2}, \alpha \right); \alpha \in \mathbb{R} \right\}$; S.P.I.

31. a) $S = \left\{ \left(\frac{-7\alpha + 13}{11}, \frac{8 + 5\alpha}{11}, \alpha \right); \alpha \in \mathbb{R} \right\}$

b) $S = \{(5, -2, -1)\}$ c) $S = \emptyset$ d) $S = \{(1, 1, 1)\}$

32. Quibe: R\$ 4,50; esfirra: R\$ 2,20; suco: R\$ 6,00.

33. R\$ 88,00

34. 14 questões erradas.