Chapter 1

Section 1.1, page 10

2. The solution is \((x_1, x_2) = (9, -5)\), or simply \((9, -5)\).
4. The point of intersection is \((-3, -5)\).
6. Replace Row 4 by its sum with \(-4\) times Row 3. After that, scale Row 4 by \(-1/7\).
8. \((0, 0, 0, 0)\)
10. \((-47, 12, 2, -2)\)
12. Inconsistent
14. \((2, -1, 2)\)
16. Consistent
18. The three planes have one point in common.
20. \(h \neq -4\)
22. \(h = 6\)

23. a. True. See the remarks following the box titled “Elementary Row Operations.”
   b. False. A \(5 \times 6\) matrix has five rows.
   c. False. The description applies to a single solution. The solution set consists of all possible solutions. Only in special cases does the solution set consist of exactly one solution. A statement should be marked True only if the statement is always true.
   d. True. See the box before Example 2.

24. a. False. The definition of row equivalent requires that there exist a sequence of row operations that transforms one matrix into the other.
   b. True. Elementary row operations do not change the solution set.
   c. False. The definition of equivalent systems is in the second paragraph after equation (2).
   d. True. By definition, a consistent system has at least one solution.

26. \(d \neq 2c\)

28. Answers may vary. The systems corresponding to the following matrices each have the solution set \(x_1 = 3, x_2 = -2, x_3 = -1\). (The tildes represent row equivalence.)

\[
\begin{bmatrix}
1 & 0 & 0 & 3 \\
0 & 1 & 0 & -2 \\
0 & 0 & 1 & -1 \\
\end{bmatrix}
\sim
\begin{bmatrix}
1 & 0 & 0 & 3 \\
2 & 1 & 0 & 4 \\
0 & 0 & 1 & -1 \\
\end{bmatrix}
\sim
\begin{bmatrix}
1 & 0 & 0 & 3 \\
2 & 1 & 0 & 4 \\
2 & 0 & 1 & 5 \\
\end{bmatrix}
\]

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2. Reduced echelon form: a. \([\begin{array}{ccc} 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & -2 \end{array}]\)

4. \([\begin{array}{cccc} 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & -2 \\ 0 & 0 & 1 & 2 \end{array}]\)

Pivot cols 1, 2, and 3:

6. \([\begin{array}{ccc} 1 & 0 \\ 0 & 1 \\ 0 & 0 \end{array}]\)

8. \(\begin{cases} x_1 = 4 \\ x_2 = 3 \\ x_3 \text{ is free} \end{cases}\)

12. No solutions

14. Inconsistent

16. a. Inconsistent
   b. Unique solution when \(h \neq 0\)
   c. Many solutions when \(h = 0\)

18. All \(h\).

20. a. Inconsistent when \(h \neq 0\)
   b. Unique solution when \(h = 0\)
   c. Many solutions when \(h \neq 0\)

   b. False. See the second paragraph after equation (2).
   c. True. Basic variables.
   d. True. A similar state to “Parametric Description”.
   e. False. The row shows \(5x_4 = 0\), which does...
30. Scale Row 3 by $-1/5$; scale Row 3 by $-5$.
32. Replace Row 3 by Row 3 + (−4)Row 2; replace Row 3 by 
Row 3 + (4)Row 2.
34. (20, 27.5, 30, 22.5)

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2. Reduced echelon form: a. Echelon form: b and d. Not in 
echelon form: c.

4. \[
\begin{bmatrix}
1 & 0 & 0 & 1 \\
0 & 1 & 0 & -2 \\
0 & 0 & 1 & 2
\end{bmatrix}
\]

Pivot cols 1, 2, and 3:

\[
\begin{bmatrix}
1 & 2 & 4 & 5 \\
2 & 4 & 5 & 4 \\
4 & 5 & 4 & 2
\end{bmatrix}
\]

6. \[
\begin{bmatrix}
1 & * \\
0 & 1 \\
0 & 0
\end{bmatrix}, \quad \begin{bmatrix}
1 & * \\
0 & 0 \\
0 & 0
\end{bmatrix}, \quad \begin{bmatrix}
0 & 1 \\
0 & 0 \\
0 & 0
\end{bmatrix}
\]

8. \[
\begin{align*}
x_1 &= 4 \\
x_2 &= 3 \\
x_3 &= \text{free}
\end{align*}
\]

10. \[
\begin{align*}
x_1 &= 2 + 2x_2 \\
x_2 &= \text{free} \\
x_3 &= -2
\end{align*}
\]

12. No solutions

14. \[
\begin{align*}
x_1 &= 3 + 5x_3 \\
x_2 &= 6 - 4x_3 + x_4 \\
x_3 &= \text{free} \\
x_4 &= \text{free} \\
x_5 &= 0
\end{align*}
\]

16. a. Inconsistent  
18. All h.

b. Consistent, with many solutions

20. a. Inconsistent when $h = -6$ and $k \neq 2$

b. Unique solution when $h \neq -6$

c. Many solutions when $h = -6$ and $k = 2$


b. False. See the second paragraph in this section.

c. True. Basic variables are defined after equation (4).

d. True. A similar statement appears at the beginning of
   “Parametric Descriptions of Solution Sets.”

e. False. The row shown corresponds to the equation
   $5x_4 = 0$, which does not by itself lead to a