2. $A+2B=\begin{bmatrix}2 & 0 & -1\\ 4 & -5 & 2\end{bmatrix}+2\begin{bmatrix}7 & -5 & 1\\ 1 & -4 & -3\end{bmatrix}=\begin{bmatrix}2+14 & 0-10 & -1+2\\ 4+2 & -5-8 & 2-6\end{bmatrix}=\begin{bmatrix}16 & -10 & 1\\ 6 & -13 & -4\end{bmatrix}$

The expression $3C-E$ is not defined because $3C$ has 2 columns and $-E$ has only 1 column.

$$CB=\begin{bmatrix}1 & 2\\ -2 & 1\end{bmatrix}\begin{bmatrix}7 & -5 & 1\\ 1 & -4 & -3\end{bmatrix}=\begin{bmatrix}1\cdot 7+2\cdot 1 & 1(-5)+2(-4) & 1\cdot 1+2(-3)\\ -2\cdot 7+1\cdot 1 & -2(-5)+1(-4) & -2\cdot 1+1(-3)\end{bmatrix}=\begin{bmatrix}9 & -13 & -5\\ -13 & 6 & -5\end{bmatrix}$$

The product EB is not defined because the number of columns of E does not match the number of rows of R.

6. **a.** $A\mathbf{b}_1 = \begin{bmatrix} 4 & -2 \\ -3 & 0 \\ 3 & 5 \end{bmatrix}\begin{bmatrix} 1 \\ 2 \end{bmatrix} = \begin{bmatrix} 0 \\ -3 \\ 13 \end{bmatrix}, \quad A\mathbf{b}_2 = \begin{bmatrix} 4 & -2 \\ -3 & 0 \\ 3 & 5 \end{bmatrix}\begin{bmatrix} 3 \\ -1 \end{bmatrix} = \begin{bmatrix} 14 \\ -9 \\ 4 \end{bmatrix}$

$$AB = \begin{bmatrix} A\mathbf{b}_1 & A\mathbf{b}_2 \end{bmatrix} = \begin{bmatrix} 0 & 14 \\ -3 & -9 \\ 13 & 4 \end{bmatrix}$$

b. $\begin{bmatrix} 4 & -2 \\ -3 & 0 \\ 3 & 5 \end{bmatrix}\begin{bmatrix} 1 & 3 \\ 2 & -1 \end{bmatrix} = \begin{bmatrix} 4\cdot 1 - 2\cdot 2 & 4\cdot 3 - 2(-1) \\ -3\cdot 1 + 0\cdot 2 & -3\cdot 3 + 0(-1) \\ 3\cdot 1 + 5\cdot 2 & 3\cdot 3 + 5(-1) \end{bmatrix} = \begin{bmatrix} 0 & 14 \\ -3 & -9 \\ 13 & 4 \end{bmatrix}$

10. $AB=\begin{bmatrix}2 & -3\\ -4 & 6\end{bmatrix}\begin{bmatrix}8 & 4\\ 5 & 5\end{bmatrix}=\begin{bmatrix}1 & -7\\ -2 & 14\end{bmatrix}$, $AC=\begin{bmatrix}2 & -3\\ -4 & 6\end{bmatrix}\begin{bmatrix}5 & -2\\ 3 & 1\end{bmatrix}=\begin{bmatrix}1 & -7\\ -2 & 14\end{bmatrix}$

18. The first two columns of AB are $A\mathbf{b}_1$ and $A\mathbf{b}_2$. They are equal since $\mathbf{b}_1$ and $\mathbf{b}_2$ are equal.

20. The second column of AB is also all zeros because $A\mathbf{b}_2 = A\mathbf{0} = \mathbf{0}$.

22. If the columns of B are linearly dependent, then there exists a nonzero vector $\mathbf{x}$ such that $B\mathbf{x} = \mathbf{0}$. From this, $A(B\mathbf{x}) = A\mathbf{0}$ and $(AB)\mathbf{x} = \mathbf{0}$ (by associativity). Since $\mathbf{x}$ is nonzero, the columns of AB must be linearly dependent.

26. Write $I_3 = [\mathbf{e}_1 \quad \mathbf{e}_2 \quad \mathbf{e}_3]$ and $D = [\mathbf{d}_1 \quad \mathbf{d}_2 \quad \mathbf{d}_3]$. By definition of AD, the equation $AD = I_3$ is equivalent to the three equations $A\mathbf{d}_1 = \mathbf{e}_1$, $A\mathbf{d}_2 = \mathbf{e}_2$, and $A\mathbf{d}_3 = \mathbf{e}_3$. Each of these equations has at least one solution because the columns of A span $\mathbf{R}^3$. (See Theorem 4 in Section 1.4.) Select one solution of each equation and use them for the columns of D. Then $AD = I_3$.

28. Since the inner product $\mathbf{u}^T\mathbf{v}$ is a real number, it equals its transpose. That is, $\mathbf{u}^T\mathbf{v} = (\mathbf{u}^T\mathbf{v})^T = \mathbf{v}^T(\mathbf{u}^T)^T = \mathbf{v}^T\mathbf{u}$, by Theorem 3(d) regarding the transpose of a product of matrices and by Theorem 3(a). The outer product $\mathbf{u}\mathbf{v}^T$ is an $n \times n$ matrix. By Theorem 3, $(\mathbf{u}\mathbf{v}^T)^T = (\mathbf{v}^T)^T\mathbf{u}^T = \mathbf{v}\mathbf{u}^T$.