1. Show that the four points $(1,1,-1), (0,-2,6), (-2,3,-13), (2,0,4)$ are coplanar. Find an equation for the plane that contains them.

2. Find a vector $\mathbf{b}$ perpendicular to $\mathbf{a} = \langle 1,3,-2 \rangle$ and a vector $\mathbf{c}$ perpendicular to both $\mathbf{a}$ and $\mathbf{b}$.

3. The lines

$$L_1 = \begin{cases} x &= 4t-5 \\ y &= 5t+2 \\ z &= -4t-1 \end{cases}, \quad L_2 = \begin{cases} x &= -2s-9 \\ y &= -s \\ z &= s+1 \end{cases}$$

intersect each other at exactly one point and therefore lie in a common plane. Find an equation for that plane.

4. Let $\mathbf{v} = \langle 5,-3,-3 \rangle$ and $\mathbf{w} = \langle 4,-4,5 \rangle$. Compute $\mathbf{x} = -2\mathbf{v} + 3\mathbf{w}$ and find a unit vector parallel to $\mathbf{x}$. Find $\mathbf{v} \cdot \mathbf{w}$ and $\mathbf{w} \times \mathbf{v}$. Are $\mathbf{v}$ and $\mathbf{w}$ parallel? Are they perpendicular?

5. Prove the *parallelogram law*: for any pair of vectors $\mathbf{v}, \mathbf{w}$

$$|\mathbf{v}+\mathbf{w}|^2 + |\mathbf{v}-\mathbf{w}|^2 = 2\left(|\mathbf{v}|^2 + |\mathbf{w}|^2\right).$$

[*Hint:* Use the relationship between $|\cdot|$ and the dot product.]

6. Let

$$\mathbf{A} = \begin{pmatrix} -1 & 4 \\ -1 & 5 \\ 4 & 5 \end{pmatrix} \quad \mathbf{B} = \begin{pmatrix} -4 & 2 \\ -2 & 9 \end{pmatrix} \quad \mathbf{C} = \begin{pmatrix} -4 & 3 & -1 & 3 \\ 1 & -2 & 6 & 7 \end{pmatrix}.$$

Of the six possible products $\mathbf{AB}$, $\mathbf{BA}$, $\mathbf{AC}$, $\mathbf{CA}$, $\mathbf{BC}$ and $\mathbf{CB}$, compute those that are defined.

7. Write the linear system

$$\begin{aligned} 2x - 5y &= 6 \\ 3x + 4y &= -7 \end{aligned}$$

as a matrix equation of the form $\mathbf{Ax} = \mathbf{b}$. Find the inverse matrix $\mathbf{A}^{-1}$ and use it to solve for x and y.

8. The solution set to the linear system

$$\begin{aligned} 2x - 3y + 4z &= 1 \\ 3x + 4y - 2z &= 1 \end{aligned}$$

is a line in $\mathbb{R}^3$. Find parametric equations for this line.

9. Find the degree 5 Taylor polynomial about $a = 0$ for

$$f(x) = 2 - x + x^2 + e^x.$$