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[6] 1. Let S_1 and S_2 be the matrices

$$S_1 = \begin{pmatrix} 0 & i \\ i & 0 \end{pmatrix}, \qquad S_2 = \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}.$$

(a) Calculate $S_1 S_2$.

(b) Calculate $S_2 S_1$.

(c) Calculate $S_1 S_2 - S_2 S_1$.

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[6] 2. Let a and b be arbitrary real numbers, and let $\mathbf{v} = \langle a+b, a-b, c\rangle$, $\mathbf{u} = \frac{1}{\sqrt{2}}\langle 1,1,0\rangle$.

(a) Calculate $\mathbf{v} - (\mathbf{u} \bullet \mathbf{v})\mathbf{u}$.

(b) Prove that $\mathbf{v} - (\mathbf{u} \bullet \mathbf{v})\mathbf{u}$ is orthogonal to $\mathbf{u}$.

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[4] 3. Calculate the determinant of

$$\begin{pmatrix} 0 & 7 & 0 & -1210 \\ 3 & 0 & -1 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 2 & 0 \end{pmatrix}$$

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[4] 4. Let A be a 3×3 matrix, and suppose that $\langle 1, 3, 0 \rangle$ and $\langle 0, 5, 2 \rangle$ are solutions to $AX = \mathbf{0}$. Find a third non-trivial solution to $AX = \mathbf{0}$. Justify your answer.

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[10] 5. Find the equation of the plane that contains the points

$$A(1,2,4), \quad B(4,5,-2), \quad C(7,11,-5).$$