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

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

- (a) Calculate S_1S_2 .
- (b) Calculate S_2S_1 .
- (c) Calculate $S_1S_2 S_2S_1$.

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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

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