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Problem 1 (25 Points)

a. Determine the norm of the vector \( \mathbf{v} = 3\mathbf{i} + 4\mathbf{j} + 0\mathbf{k} \). Express vector \( \mathbf{v} \) in terms of its norm and the rectangular form of its unit vector.

b. Vectors \( \mathbf{A} \) and \( \mathbf{B} \) shown in the figure below have a magnitude of \( |\mathbf{A}| = 2 \) and \( |\mathbf{B}| = \sqrt{2} \). Calculate the dot product \( \mathbf{A} \cdot \mathbf{B} \).

c. If vector \( \mathbf{B} \) shown in the figure above has components (1,1,0), determine the projection of vector \( \mathbf{A} \) on vector \( \mathbf{B} \).
Problem 2 (25 Points)

Use the rectangular component method to solve the following problem. Determine:
(a) the magnitude $R$ of the resultant of the two forces shown in the figure; and
(b) the angles $\theta_x$, $\theta_y$, and $\theta_z$ between the line of action of the resultant and the positive x-, y-, and z-coordinate axes.

$F_1 = 12 \text{ kN}$

$F_2 = 10 \text{ kN}$
Problem 3 (25 Points)

Solve the following system of linear equations by Gauss-Jordan Elimination method, reducing it all the way to the row echelon form.

\[
\begin{align*}
3x_1 - 3x_2 + x_3 &= 1 \\
-x_1 + x_2 + 2x_3 &= 2 \\
2x_1 + x_2 - 3x_3 &= 0
\end{align*}
\]

NOTE: Show all work and calculations
Problem 4 (25 Points)

Two forces \( P \) and \( Q \) are applied as shown to an aircraft connection. The connection is in equilibrium when \( P = 400 \) lb and \( Q = 520 \) lb.

a) Draw a complete and separate free body diagram for this problem

b) Determine the magnitude of the force exerted on rod A

c) Determine the magnitude of the force exerted on rod B