Please state clearly all assumptions made in order for full credit to be given.

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Problem #1 (25) In a 3D Cartesian coordinate system,

(a) Determine vector \( \mathbf{A} \) that is initiated from \((-4, 2, -5)\) and terminated at \((3, -1, 0)\); (3)
(b) Determine the norm of \( \mathbf{A} \); (3)
(c) Determine vector \( \mathbf{V} \) that has magnitude of 7 and the same direction as \( \mathbf{A} \); (4)
(d) If vector \( \mathbf{C} = 4\mathbf{i} + 9\mathbf{j} \) and \( \mathbf{C} = 2\mathbf{A} - 5\mathbf{B} \), determine vector \( \mathbf{B} \); (4)
(e) Determine the angle \( \theta \) between \( \mathbf{A} \) and \( \mathbf{C} \); (4)
(f) Determine the vector component of \( \mathbf{A} \) along \( \mathbf{C} \); (4)
(g) Determine the scalar component of \( \mathbf{A} \) orthogonal to \( \mathbf{C} \). (3)

Note: show all steps.
Problem #2 (25)

Two concurrent forces $\mathbf{F}_1$ and $\mathbf{F}_2$ act on a hook as shown below. $\mathbf{F}_1$ is 400 N and $\mathbf{F}_2$ is 800 N. $\mathbf{F}_1$ makes an angle of $50^\circ$ with the positive y-axis and an angle of $70^\circ$ with the positive z-axis. $\mathbf{F}_2$ makes an angle of $30^\circ$ with its projection on xy plane.

a) Express each force in Cartesian vector form. (6)
b) Determine the angle between the two forces $\mathbf{F}_1$ and $\mathbf{F}_2$ in degrees. (5)
c) Determine the resultant of the two forces in Cartesian vector form. (4)
d) Determine the magnitude of the resultant in N. (4)
e) Determine the angles between the resultant and the 3-coordinate axes in degrees. (6)

Note: You need to show all work to receive full credit.
Problem #3 (25)

Three ropes are connected at O as shown. Two of the ropes, with tensions $T_1$ and $T_2$ respectively, support two boxes through two frictionless pulleys, as shown in the figure. The masses of the boxes are: $m_1 = 3 \text{ kg}$ and $m_2 = 5 \text{ kg}$, respectively. An object is supported by the third rope with tension $T$. Determine the mass of the object, $m$, such that $\theta_1 + \theta_2 = 90^\circ$ all objects are at rest. To receive full credit, you must show all steps and draw separate and complete free-body-diagram necessary for solving the problem.
Problem #4 (25)

Be careful of the signs (+/-) in the problem statement.

Solve the following system of linear equations using Gauss-Jordan elimination method:
\[ \begin{align*}
    x_1 - x_2 + 3x_3 &= 4 \\
    x_1 + 2x_2 - 2x_3 &= 10 \\
    3x_1 - x_2 + 5x_3 &= 14
\end{align*} \]

a) Show the augmented matrix
b) Use elementary row operations to obtain the reduced row echelon form
c) Write the solution for the three variables \( x_1, x_2, \) and \( x_3 \)

Note: To receive full credit, all intermediate work (e.g. elementary row operations should be shown.)