

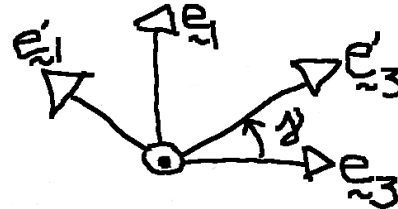
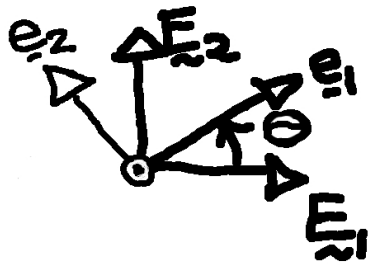
Andrew's Special Homework Oktoberfest Version

On all dynamics problems, remember to explicitly set up all coordinate systems, draw free body diagrams, and write down all coordinate transformation matrices. In judging partial credit, these items will be given the highest consideration.

Coordinates, when supplied, should be considered as a suggestion. Make sure you define whatever coordinates you use so that the reader can compare your coordinates with your final answer.

1. Coordinate Transformation Matrix

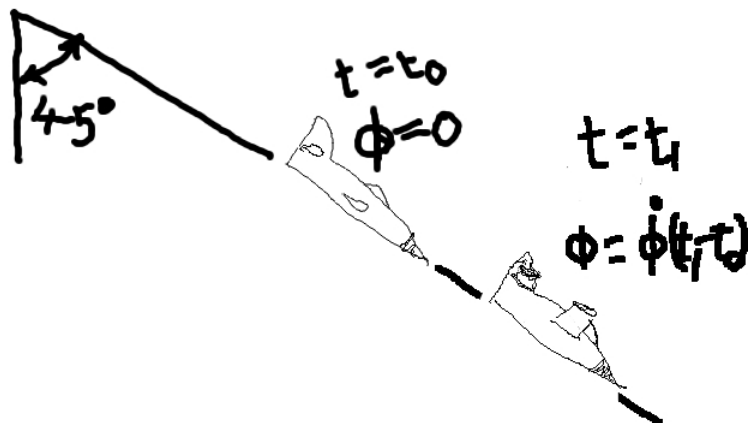
Given the following coordinate systems, where $\hat{i}, \hat{j}, \hat{k}$ is inertial and $\hat{e}_1, \hat{e}_2, \hat{e}_3$ is body fixed, what are the coordinate transformation matrices ($e_j \cdot E_i$ and $e'_k \cdot e_j$) corresponding to the figure, and what is the angular velocity of the body?



NOTE: $E_1 = i, E_2 = j, E_3 = k$
 $e_1 = i', e_2 = j', e_3 = k'$

2. Kinematics (Velocity and Acceleration)

An airplane is in a power dive at an angle of 45° (γ) to the vertical. The airplane is rotating about the axis of its dive with a constant angular rate, $\dot{\phi}$. If the wing tip is a distance, L , from the dive axis, what is the absolute acceleration of the wing tip in inertial coordinates?



3. Given the coordinate transformation matrix, $A = \begin{bmatrix} .814 & .342 & .470 \\ -.296 & .940 & -.171 \\ -.500 & 0 & .866 \end{bmatrix}$, that

transforms the i, j, k system to the i', j', k' system. What are the nine angles between each of the unit vectors in the two coordinate systems? Show that this CTM is orthonormal, $AA^T = A^T A = I$.

What are the three components of the vector, \hat{j} , when expressed in the i', j', k' system?

What are the components of $v = 0.5i + 2j + 3k$ in the i', j', k' system?