

**Problem U3 (Unified Concepts)**

In this question you are asked to examine forces and moments as vectors in 3 D

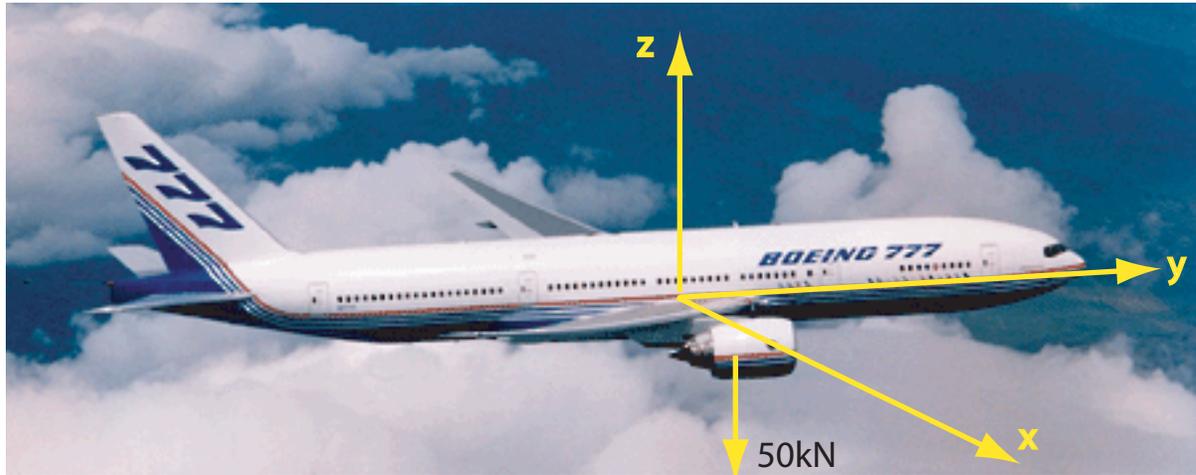


Image taken from NASA's website. <http://www.nasa.gov>.

A twin engine transport aircraft has its engines positioned such that their center of mass is forward of the wings. Each engine is attached by a strut. The wings are swept back at an angle of about  $25^\circ$ , and have a slight upward dihedral angle. Using a coordinate system centered on the starboard wing root (where the wing intersects the fuselage), the center of mass of the starboard engine is at a point with position vector  $\mathbf{r}_1 = 2.0\mathbf{i} + 1.5\mathbf{j} + 3.0\mathbf{k}$  m. The position vector of

the port wing tip, T, is  $\mathbf{r}_2 = 14.0\mathbf{i} + 3.0\mathbf{j} + 2.0\mathbf{k}$  m. The weight of the engine is 50000 N and acts vertically

downward through the center of mass. Answer the following questions, expressing your answers as vectors.

- What is the moment created by the weight of the port engine about the wing root?
- What is the component of this moment acting along the line OT?
- What is the component of this moment acting perpendicular to the direction of the wing?
- Physically what do the components of the moment you calculated in b) and c) do to the wing?