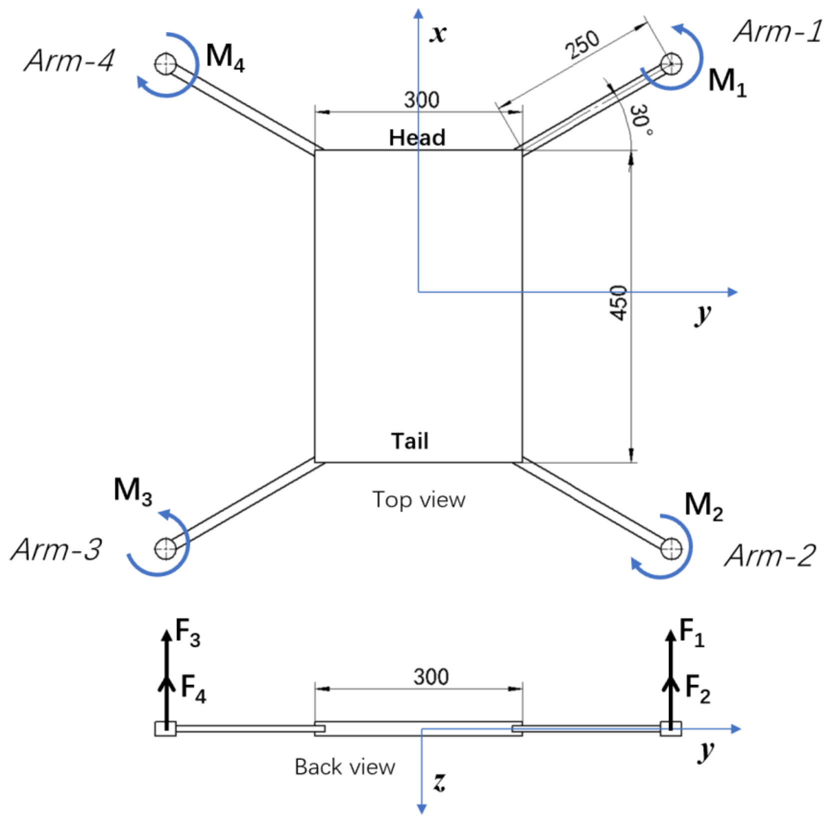
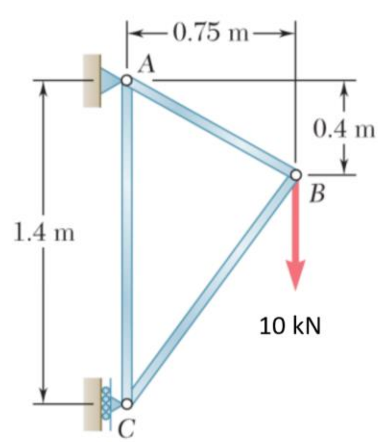
Q1. The figure below shows the central body and four arms of a quadrotor. The top view, back view, and dimensions are given, length unit is mm. The propellers are not part of this rigid body. The propellers apply trust forces F_1, F_2, F_3, F_4 on the tip of four arms, respectively, as shown in the back view. The propellers also apply couples M_1, M_2, M_3, M_4 at the tip of four arms, respectively, as shown in the top view, note their directions.



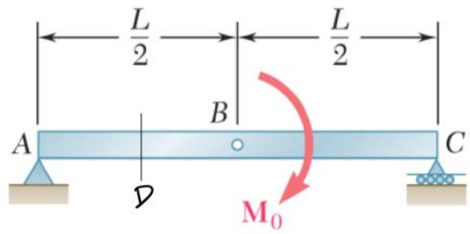
(1) In the hovering (悬停) state, if the weight of the body is about 40 g, determine the magnitude of the trust forces F_1, F_2, F_3, F_4. Using kilogram-force (kgf) as the unit of force to present your answer, 1 kgf is equal to a mass of one kilogram multiplied by the standard acceleration due to gravity on Earth.

(2) At an instant, for a set of forces and couples: F_1=0.04 kgf, F_2=0.044 kgf, F_3=0.06 kgf, F_4=0.064 kgf, M_1=0.1 kgf*mm, M_2=0.11 kgf*mm, M_3=0.15 kgf*mm, M_4=0.16 kgf*mm, determine the equivalent force-couple system at the center of the body. **Present your results using the components along x, y, and z axes.**

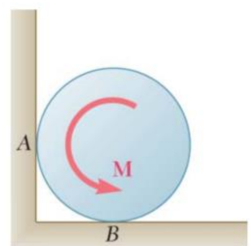
Q2. Using the method of joints, determine the force in each member of the truss below. State whether each member is in tension or compression.



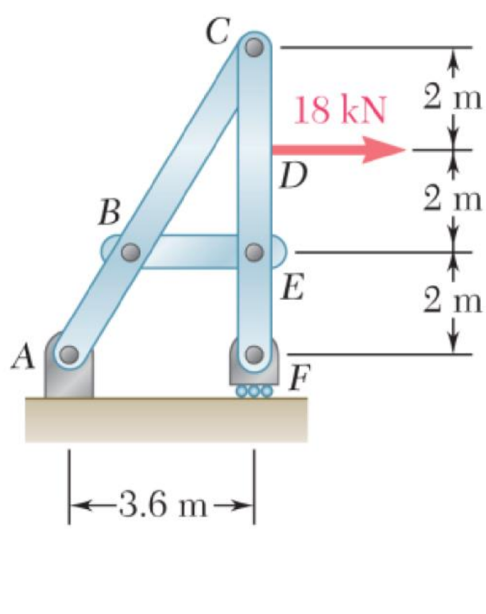
Q3. For the beam and loading shown, the couple M_0 is applied at point B, (a) determine the reactions at the supports, (b) determine the internal forces and bending moment at point D that is the middle point of AB.



Q4. The cylinder shown is of weight W and radius r, and the coefficient of static friction μ_s is the same at A and B. Determine the magnitude of the largest couple **M** that can be applied to the cylinder if it is not to rotate.



Q5. For the frame and loading shown, a) point out which member is a two-force member, b) determine the components of all forces acting on member ABC.



Q6. (a) For a system of material points, the position vector of each particle is denoted by $\vec{r}_i$, mass of each particle is denoted by m_i, write the vector-form equation that defines the position vector of the center of mass of the system of particles.

(b) Use only vector operations to prove the following statement: for any two-force member to be in equilibrium, the two forces acting on the member must have the same magnitude, act in opposite directions, and have the same line of action, directed along the line joining the two points where these forces act.