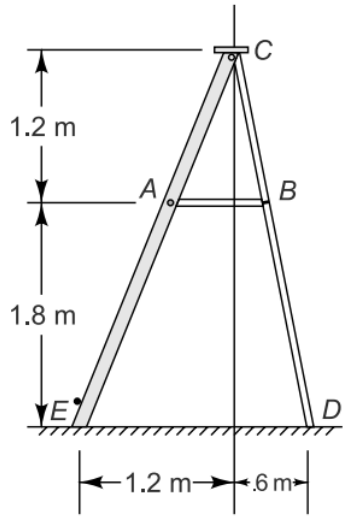
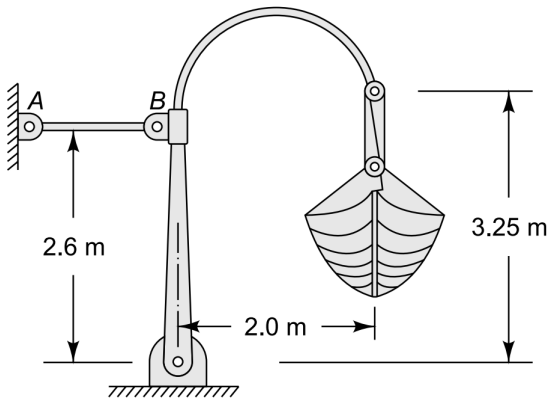
Tutorial 1: Study of forces

APL 108 - 2025 (Solid Mechanics)

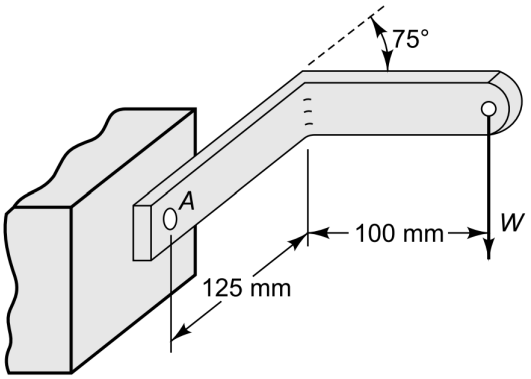
1. A light stepladder is resting on the floor as shown below. Calculate the forces in the link AB when a person of weight 800 N stands on top of the ladder. Assume the bars to be weightless, the pins to be frictionless and the surface to be smooth.
   Also, repeat the analysis when the surface has a coefficient of friction of 0.2.



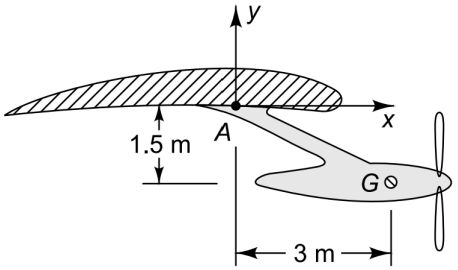
2. Estimate the force in link AB when the weight of the boat supported by the davit is 7 kN.



3. A spot weld which holds the bracket to the plate at point A, as shown in the figure below, can withstand a maximum bending in the plane of the plate of 100 Nm. Determine the allowable maximum load W.



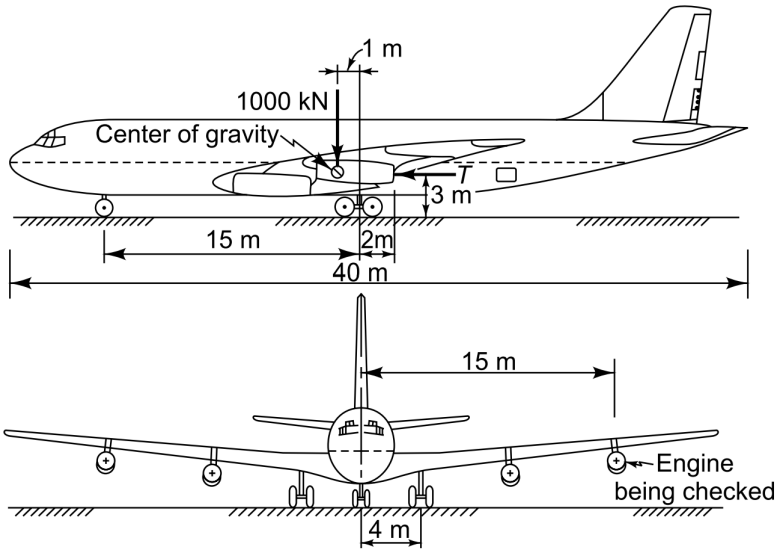
4. An airplane engine pod is suspended from the wing by the strut AG shown. The propeller turns clockwise when viewed from behind. The weight of the engine is 11 kN and may be assumed to act at G. Find the force and moment exerted by the strut onto the wing at A when the engine is delivering 17.5 kN thrust and 20 kNm of torque.



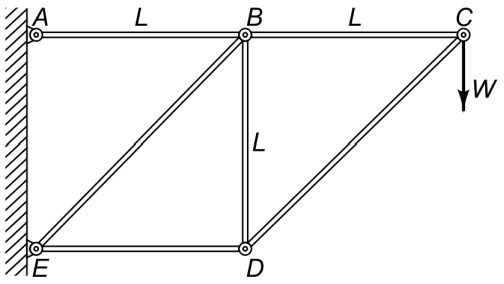
5. A four-engine jet transport, which weighs 1000 kN fully loaded, has its center of gravity at the location shown in the sketch. Before taking off, the pilot must test the engines by operating them, one at a time, at a thrust of about 40 kN. As he checks the left outboard engine, the other three engines idle at negligible thrust. The rear-wheel brakes are locked during the test, but the nose wheel has no brakes. In addition, the nose wheel is mounted on a caster, so it cannot resist a sidewise force.

   (a) What forces does the ground exert on the landing wheels during the test?

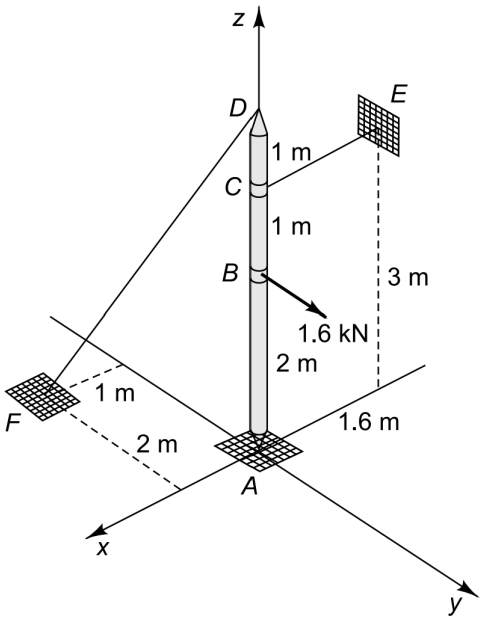
   (b) What must the coefficient of friction between the ground and wheels be to prevent the rear wheels from slipping?



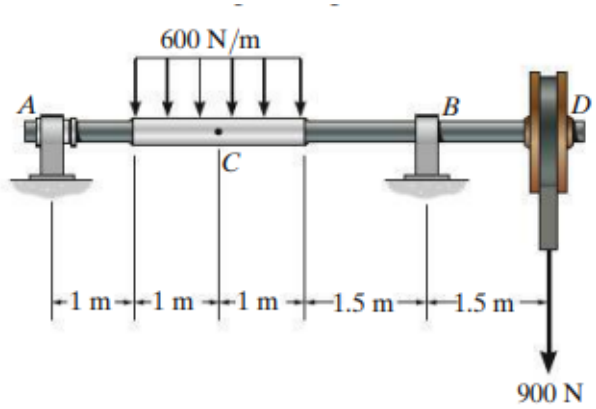
6. Determine the forces in the six members of the truss shown.



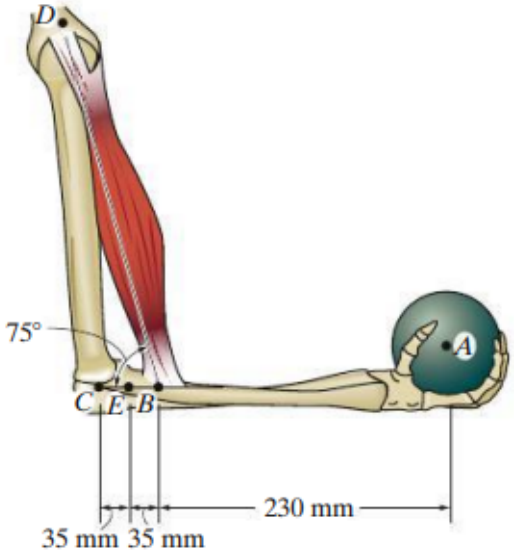
7. The mast AD is acted on by a 1.6 kN force and supported by cables CE and DF as shown. Find the reaction force exerted on the mast by the frictionless ball-and-socket joint at A and also the tensions in the cables CE and DF.



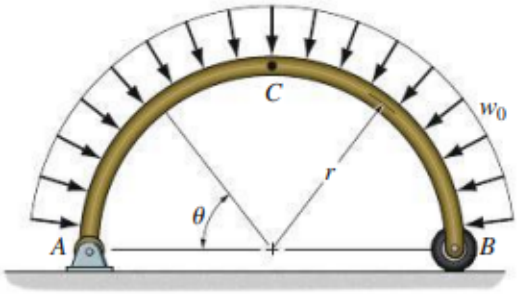
8. The shaft is supported by a smooth thrust bearing at A and a smooth journal bearing at B. Determine the resultant internal loading acting on the cross-section at C.



9. The forearm and biceps support the 2-kg load at A. If C can be assumed as a pin support, determine the resultant internal loadings acting on the cross-section of the bone of the forearm at E. The biceps pulls on the bone along BD.



10. Determine the resultant internal loadings acting on the cross-section of the semicircular arch at C.



11. The shaft is supported at its ends by two bearings A and B and is subjected to the forces applied to the pulleys fixed to the shaft. Determine the resultant internal loadings acting on the cross-section located at point C. The 300 N forces act in the z-direction and the 500 N forces act in the $+x$ direction. The journal bearings at A and B exert only x and z components of force on the shaft.