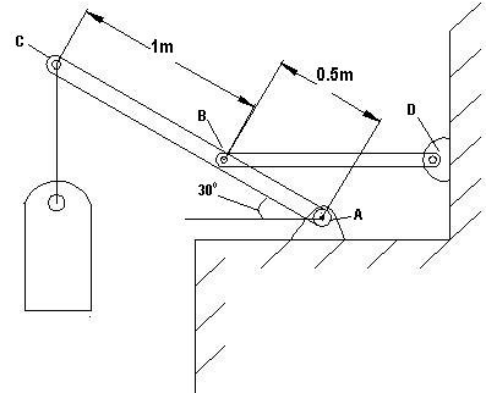


TUTORIAL SHEET 3

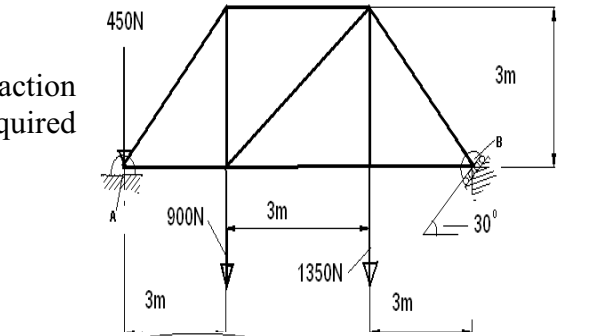
FREE BODY DIAGRAMS AND STATIC ANALYSIS

- Consider the uniform rod ABC supported by a pin at A and short link BD. draw the free-body diagrams and determine the total number of unknown force and couple magnitudes and/or directions. Neglect the weight of the members.



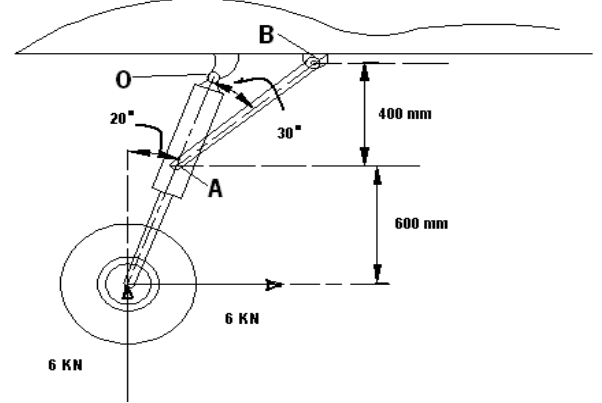
- Determine the horizontal and vertical components of reaction at the pin A and the reaction at the roller support B required for equilibrium of the truss.

Ans: $A=683i + 1500j$ N, $B=1386$ N



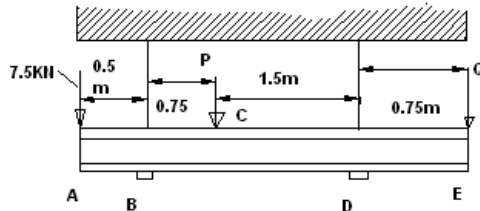
- As an airplane's brakes are applied, the nose wheel exerts two forces on the end of the landing gear as shown. Determine the x and y components of reaction at the pin C and the force in strut AB.

Ans: $F_{AB} = 865$ N, $C=2.7i + 6.6j$ kN



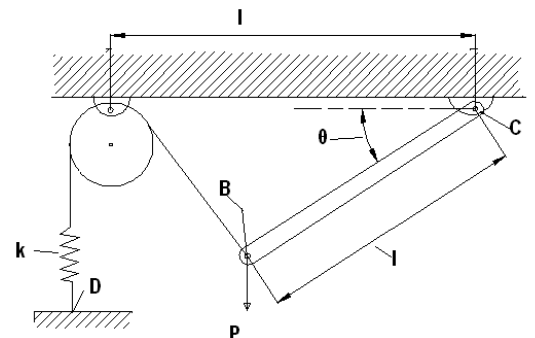
- Three loads are applied to a light beam supported by cables attached at B and D knowing that the maximum allowable tension in each cable is 12kN and neglecting the weight of the beam, determine the range of values of Q for which the loading is safe when $P = 5$ kN.

Ans: $1.5kN \leq Q \leq 9kN$



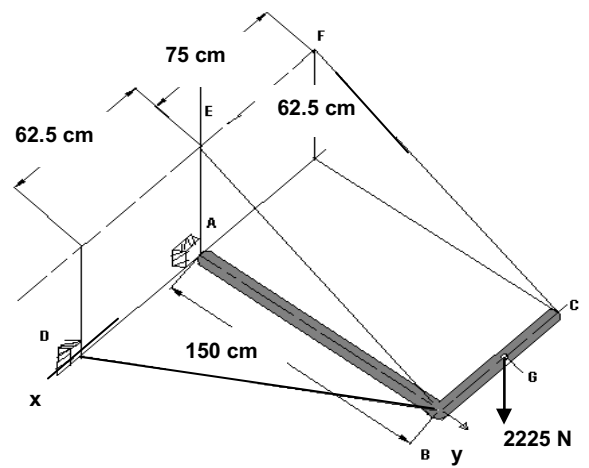
- A vertical load P is applied at the end B of rod BC. The constant of the spring is K and the spring is outstretched when $\theta = 0$. (a) Neglecting the weight of the rod, express the angle θ corresponding to the equilibrium position in terms of P, K and l. (b) Determine the value of θ corresponding to the equilibrium if $P = 2kl$.

Ans: $\theta = \tan^{-1}(P/Kl)$, $\theta = 63.44^\circ$



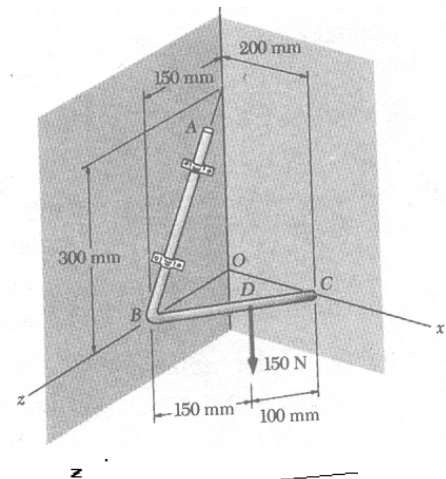
6. The rigid L – shaped member ABC is supported by a ball and socket at A and by three cables. Determine the tension in each cable and the reaction at A caused by the 2225N load applied at G.

Ans: $T_{CF} = 2.9 \text{ kN}$, $T_{BE} = 2.9 \text{ kN}$, $T_{BD} = 3.5 \text{ kN}$,
 $A = -1.33i + 8.5j \text{ kN}$



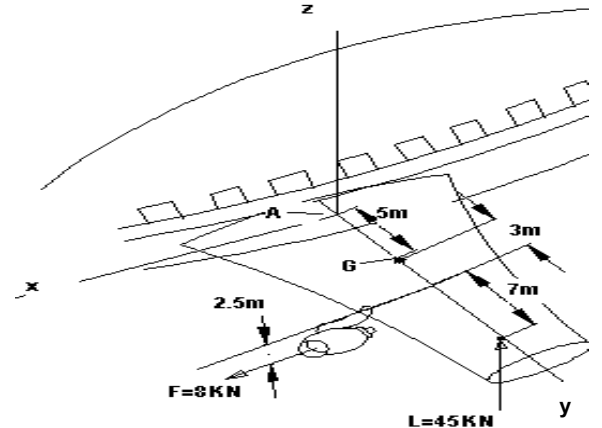
7. The bent rod ABC is hinged to a vertical wall by means of two brackets and bears at C against another vertical wall. Upper bracket fits in a groove in the rod to prevent the rod from sliding down. Neglecting friction, determine the reaction at C when a 150N load is applied at D as shown.

Ans: $C = 45i \text{ kN}$



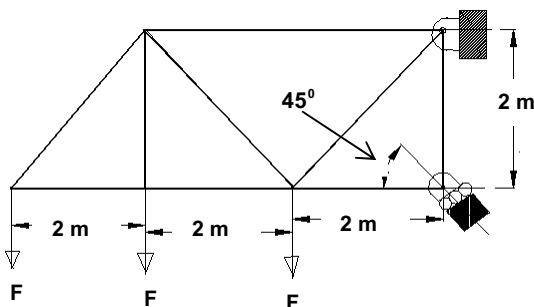
8. The wing of the jet aircraft is subjected to thrust of $F = 8 \text{ kN}$ from its engine and the resultant lift force $L = 45 \text{ kN}$. If the mass of the wing is 2100 kg. and the mass centre is at G, determine the x, y, z components of reaction where the wing is fixed to the fuselage at A.

Ans: $M_A = -572i + 20j + 64k \text{ kNm}$



9. Consider the truss. If the roller at B can sustain a maximum load of 3KN, determine the largest magnitude of each of the three forces F that can be supported by the truss.

Ans: $F = 354 \text{ N}$



10. Two smooth tubes A and B, each having the same weight W , are suspended at their ends by cords of equal length. A third tube C is placed between A and B. Determine the greatest weight of C without upsetting equilibrium. Ans: $W_C = 0.776 W$

