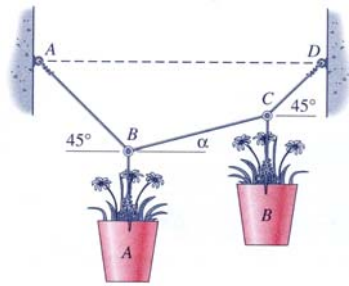


HOMEWORK 3

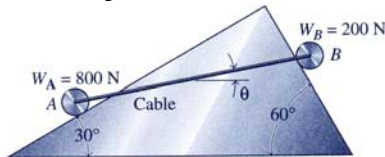
1. Two flower pots are supported with cables as shown in the figure. If pot A weighs 10 N and pot B weighs 8 N, determine (i) the tension in each of the cables, and (ii) the slope of cable BC. (Ans: $T_{AB}=12.73N, T_{BC}=9.06N, T_{CD}=12.73N, \alpha = 6.34^\circ$)



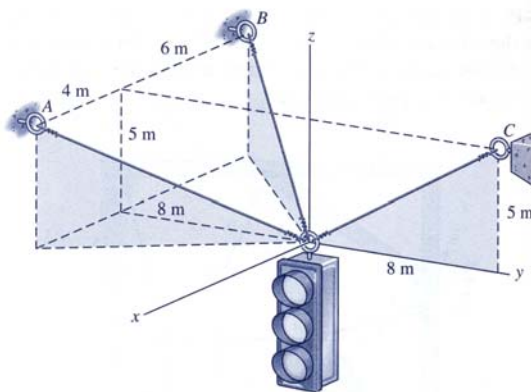
2. Two bodies A and B weighing 800 N and 200 N, respectively, are held in equilibrium on perpendicular surfaces by a connecting flexible cable that makes an angle θ with the horizontal. If all surfaces are smooth, determine:

- (i) The reactions of the surfaces on the bodies.
- (ii) The tension in the cable AB.
- (iii) The angle θ .

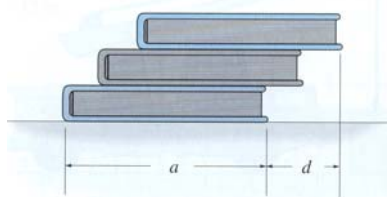
(Ans: $N_A=866N, N_B=500N, T=436N, \theta = 6.59^\circ$)



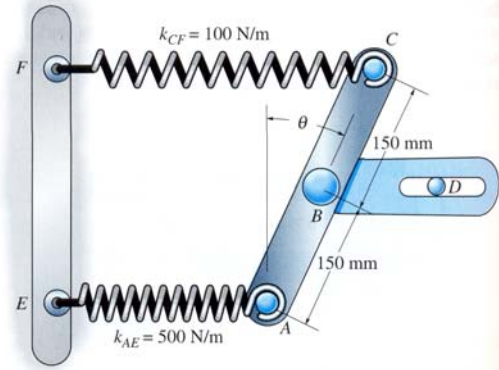
3. A 100-kg traffic light is supported by a system of cables as shown. Determine the tension in each of the cables. (Ans: $T_A=603N, T_B=439N, T_C=925N$)



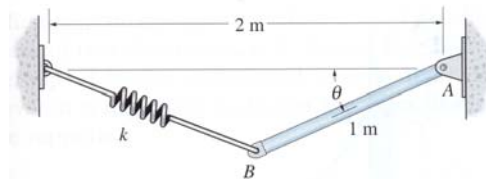
4. Three uniform books, each having a weight of W and length a , are stacked as shown. Determine the maximum distance d that the top book can extend out from the bottom one so that the stack does not topple over. (Ans: $d=3a/4$)



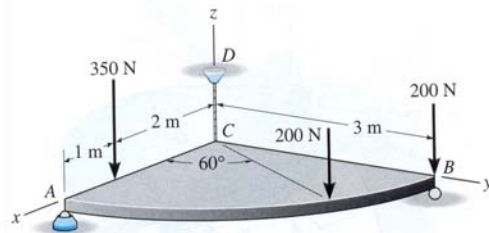
5. Determine the angle θ at which the link ABC is held in equilibrium if member BD moves 50 mm to the right. The springs are originally unstretched when $\theta = 0^\circ$. The springs remain horizontal since they are attached to the roller guides. (Ans: $\theta = 12.84^\circ$)



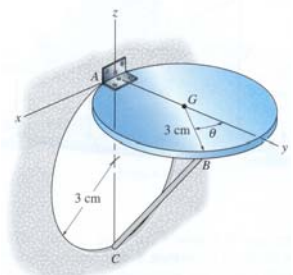
6. The uniform rod AB has a weight of 150 N and the spring is unstretched when $\theta = 0^\circ$. If $\theta = 30^\circ$, determine the stiffness k of the spring. (Ans: $k=336.8N/m$)



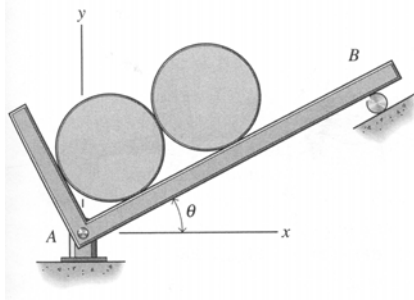
7. Determine the force components acting on the ball-and-socket at A, the reaction at the roller B, and the tension on the cord CD needed for equilibrium of the circular plate. (Ans: $A_z=333.33N, B_z=373.2N, T_{CD}=43.47N$)



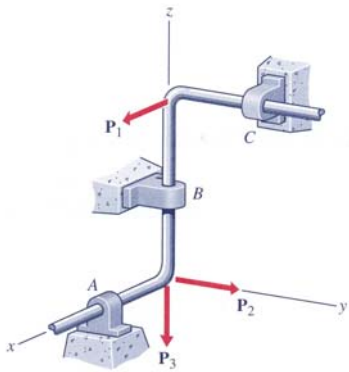
8. The circular door has a weight of 55 N and a center of gravity at G. Determine the x, y, z components of reaction at the hinge A and the force acting along strut CB needed to hold the door in equilibrium. Set $\theta = 90^\circ$. (Ans: $M_A=165Nm \mathbf{i} + 330Nm \mathbf{j}, F_A = -55N \mathbf{i} - 55N \mathbf{j} - 55N \mathbf{k}, F_{CB} = 55N \mathbf{i} + 55N \mathbf{j} + 110N \mathbf{k}$)



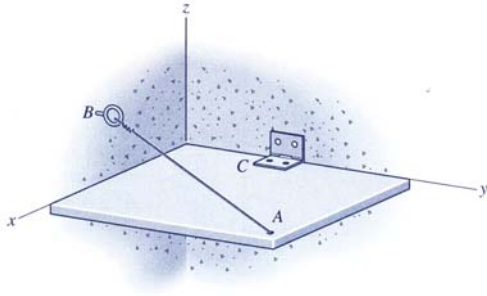
9. Draw a free-body diagram of the bracket shown. The contact surfaces between the cylinders and bracket are smooth.



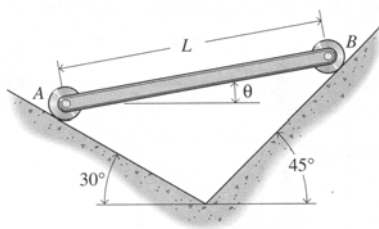
10. Draw a free-body diagram of the bar shown. The support at A is a journal bearing and the supports at B and C are ball bearings.



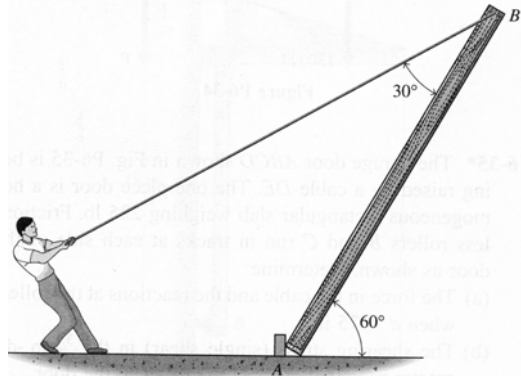
11. Draw a free-body diagram of the door shown. The homogeneous door has weight **W**.



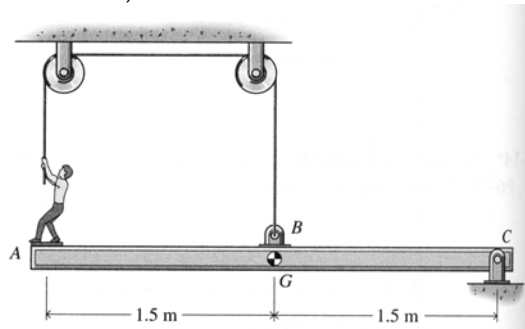
12. Bar AB has a uniform cross section, a mass of 25 kg, and a length of 1 m. Determine the angle θ for equilibrium. (Ans: $\theta = 20.10^\circ$)



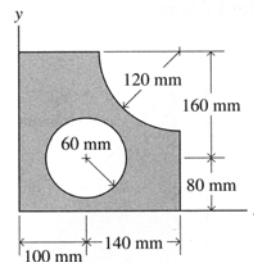
13. A man is slowly raising a 10 m long homogeneous pole weighing 150 N as shown in the figure. The lower end of the pole is kept in place by smooth surfaces. Determine the force exerted by the man to hold the pole in the position shown. (Ans: $F = 75N$)



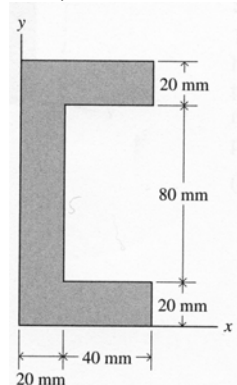
14. The man shown in the figure has a mass of 75 kg and the beam has a mass of 40 kg. The beam is in equilibrium with the man standing at the end and pulling on the cable. Determine the force exerted on the cable by the man and the reaction at support C. (Ans: $T=620.3N$, $C=114.45N \downarrow$)



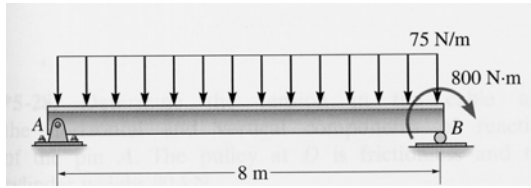
15. Locate the centroid of the shaded area shown. (Ans: $x_c=116.02mm$, $y_c=123.24mm$)



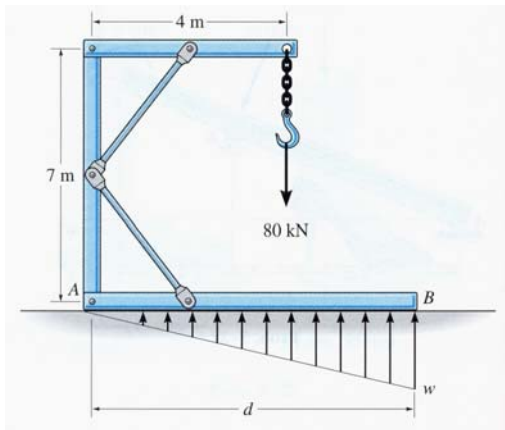
16. Locate the centroid of the shaded area shown. (Ans: $x_c=22mm$, $y_c=60mm$)



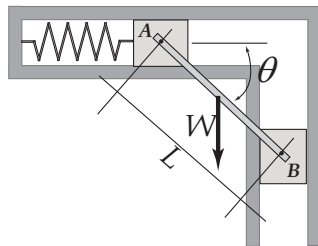
17. Determine the reactions at the supports. (Ans: $B_y=400N$, $A_x=0$, $A_y=200N$)



18. The framework is supported by the member AB which rests on the smooth floor. When loaded, the pressure distribution on AB is linear as shown. Determine the smallest length d of member AB so that it will prevent the frame from tipping over. What is the intensity w in this case? (Ans: $d=6m$, $w=26.7kN/m$)

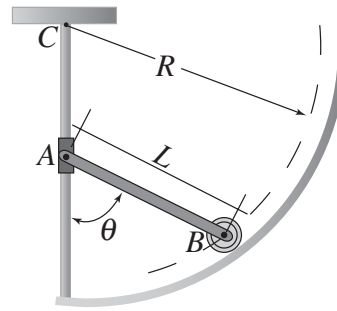


19. A slender rod AB , of weight W , is attached to blocks A and B which move freely (no friction) in the guides shown. The constant of the spring is k , and the spring is not stretched when $\theta = 0^\circ$. Neglecting the weight of the blocks, derive an equation in W , k , L , and θ which must be satisfied when the rod is in equilibrium.



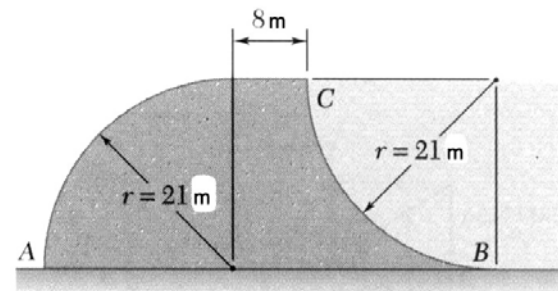
(Ans: $\frac{W}{2kL} = \tan \theta(1 - \cos \theta)$)

20. A slender rod of length L and weight W is attached to a collar at A and is fitted with a small wheel at B . Knowing that the wheel rolls freely along a cylindrical surface of radius R , and neglecting friction, derive an equation in θ , L , and R which must be satisfied when the rod is in equilibrium.

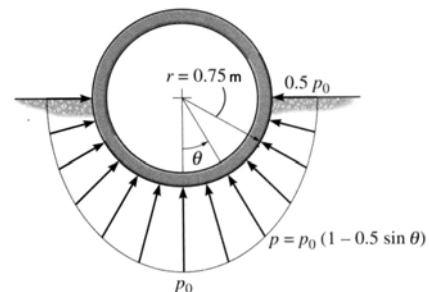


(Ans: $3 \cos^2 \theta = \left(\frac{R}{L}\right)^2 - 1$)

21. The cross section of a concrete dam is as shown. For a $1m$ wide dam section determine (a) the resultant of the reaction forces exerted by the ground on the base AB of the dam, (b) the point of application of the resultant of part a, (c) the resultant of the pressure forces exerted by the water on the face BC of the dam. Specific weight of water is 10 kN/m^3 , and the specific weight of the dam is 23.6 kN/m^3 . (Ans: $\mathbf{F}_R = 2205kN \mathbf{i} + 17835.5kN \mathbf{j}$, $x=22.4m$ from A , $|\mathbf{P}_R| = 4105.58kN$ along $\theta = 237.5^\circ$ from the $+x$ axis)



22. The support exerts the distributed loading on the pipe. If the pipe weighs $50N$ and has a length of $3m$ (into the paper), determine the magnitude of p_0 for equilibrium. (Ans: $p_0=14.81N/m^2$)



23. Eight identical $500 \times 750\text{mm}$ rectangular plates, each of mass $m=40\text{ kg}$, are held in a vertical plane as shown. All connections consist of frictionless pins, rollers, or short links. In each case, determine whether (a) the plate is completely, partially, or improperly constrained, (b) the reactions are statically determinate or indeterminate, (c) the equilibrium of the plate is maintained in the position shown. Also, wherever possible, compute the reactions.

