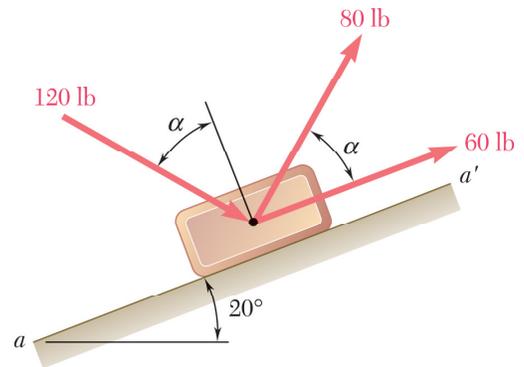


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Homework #1 – Forces and Moments as Vectors

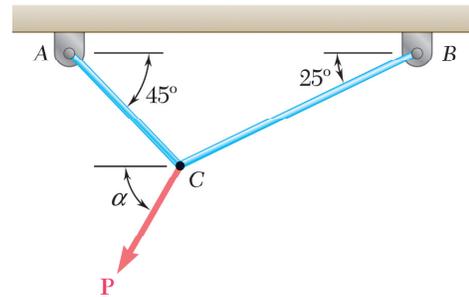
Due: June 14, 2016 @ 10:30am

ASSIGNED

- 1) Knowing that $\alpha = 40^\circ$, determine the resultant of the three forces shown:

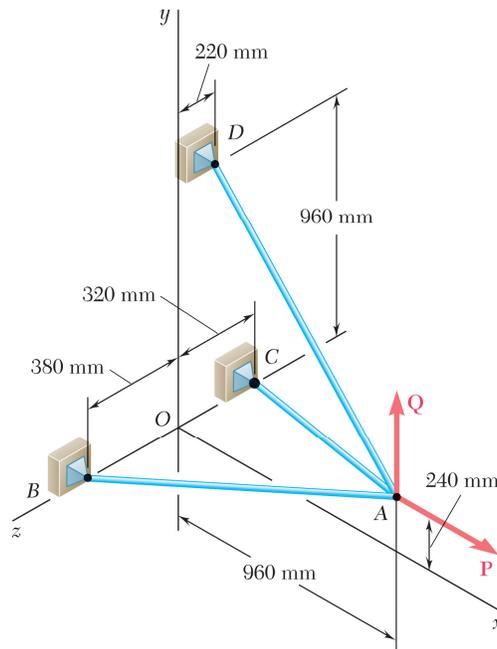


- 2) Two cables, AC and BC, are tied together at C and pulled by a force P , as shown. Knowing that $P = 500$ N, $\alpha = 60^\circ$, and that the resultant force on point C is 0 N, determine the tension in:



- a. Cable AC
- b. Cable BC

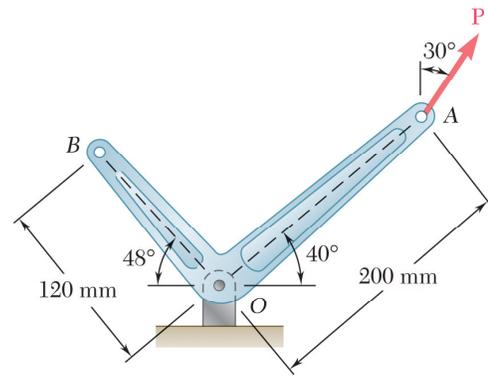
- 3) Three cables are connected at A, where the forces P and Q are applied, as shown. Knowing that $Q = 0$, find the value of P for which the tension in cable AD is 305 N.



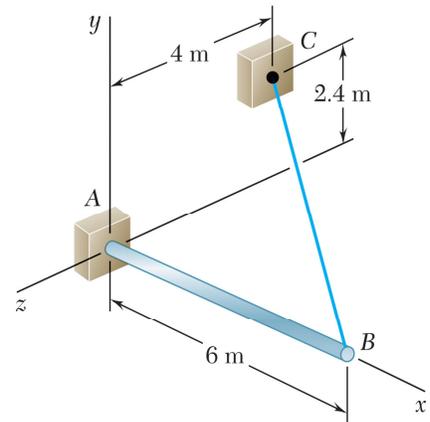
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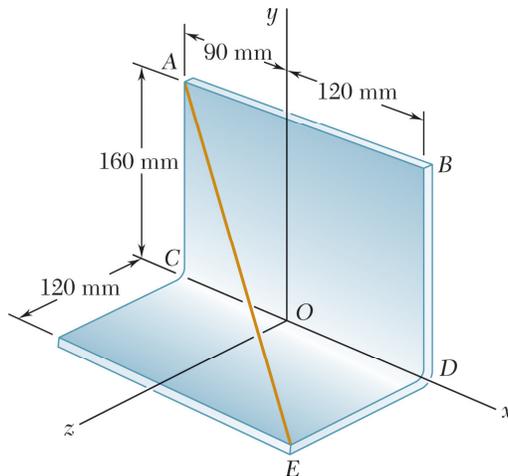
- 4) A 300 N force **P** is applied at Point A of the bell crank **shown**. Compute the moment of the force **P** about point **O**:
- By resolving it into horizontal and vertical components first, then adding the moments from each of these components
 - By evaluating the cross product: $\vec{M}_O = \vec{r} \times \vec{F}$
 - Determine the perpendicular distance from point **O** to the line of action of **P**



- 5) The 6 m boom AB has a fixed end A. A steel cable is stretched from the free end B of the boom to a point C located on the vertical wall. If the tension in the cable is 2.5 kN, determine the moment about A of the force exerted by the cable at B.



- 6) The wire AE is stretched between the corners A and E of a bent plate. Knowing that the tension in the wire is 435 N, determine:
- The moment about point O due to the force exerted on point A
 - The moment about point O due to the force exerted on point E
 - The resultant moment due to all forces on the plate from the wire. What type of motion do we expect to result from the wire tension?



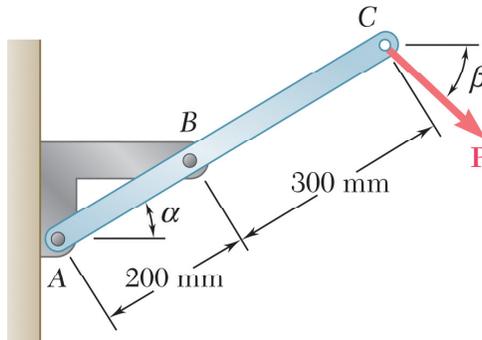
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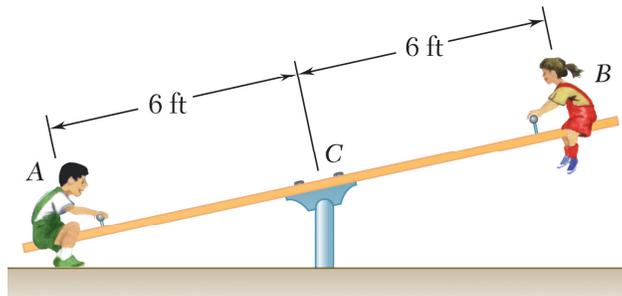
TRY

** Read ahead to sections: 3.16 – 3.20

- 1) The force P has a magnitude of 250 N and is applied at the end C of a 500 mm rod AC attached to a bracket. Assuming $\alpha = 30^\circ$ and $\beta = 60^\circ$, determine:
 - a. The equivalent force-couple system acting at point B
 - b. An equivalent system formed by two parallel forces applied at A and B



- 2) The weights of two children sitting at ends A and B of a see-saw are 84 lb and 64 lb, respectively. Where should a third child sit so that the resultant of the weights (i.e. – force-couple system equivalent to the system of forces created by the children's weight) of the three children will pass through C if she weighs:
 - a. 60 lb
 - b. 52 lb



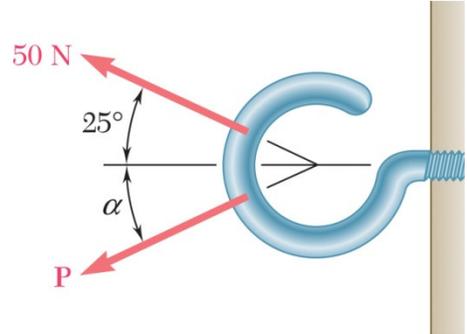
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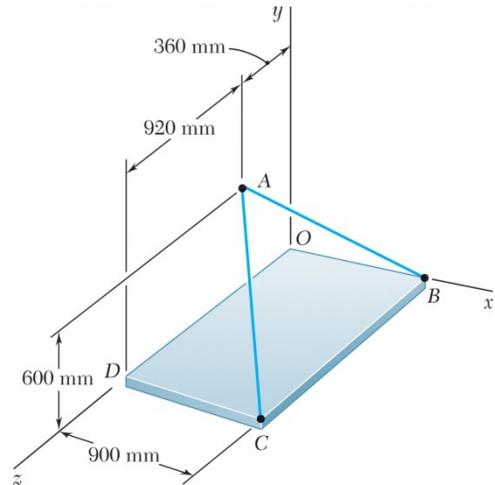
PRACTICE

** “Warm-Up” Problems to help practice the basic calculations needed for assigned problems

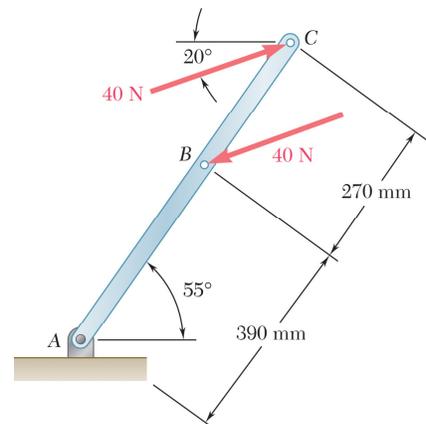
- 1) Two forces are applied as shown to a hook support. Knowing that the magnitude of \mathbf{P} is 35 N, show that the required angle α to make the resultant \mathbf{R} of the two forces applied to the hook to be horizontal is the same using:
 - a. Geometric solution
 - b. X-Y component solution
 - c. Determine the corresponding magnitude of the resultant \mathbf{R} using both geometric and X-Y component methods



- 2) Knowing that the tension in cable AB is 1425 N, determine:
 - a. The unit vector that points from point B to point A
 - b. The x-y-z components of the cable tension force from the cable AB



- 3) Two parallel 40 N forces are applied to a lever as shown. Determine the moment of the couple formed by the two forces:
 - a. By resolving each 40 N force into X-Y components and adding the moments of the resulting X-direction couple with the Y-direction couple
 - b. By using the perpendicular distance between the two 40 N forces
 - c. By summing the moments from each of the 40 N forces about point A



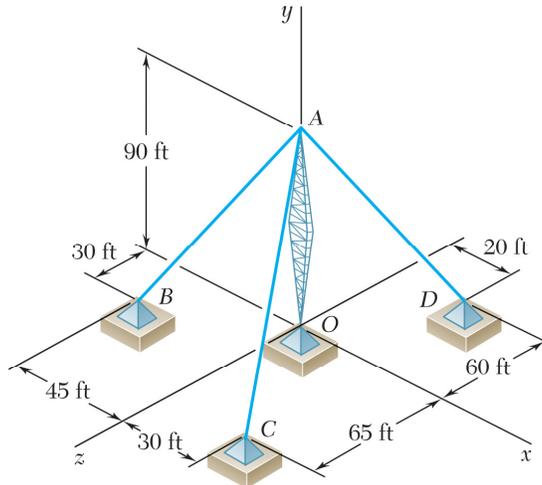
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CHALLENGE

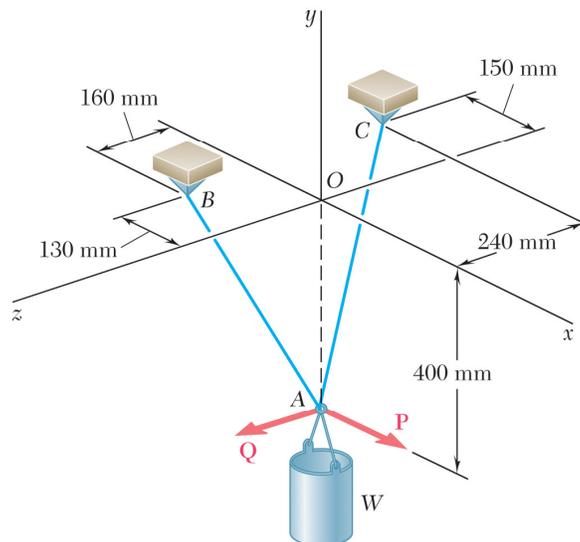
** Further Practice: Problems with a bit more challenge to them to test your understanding. Expect to see some problems like these on the exam

- 1) A transmission tower is held by three support wires attached to pin A and anchored by bolts at B, C, and D. The cables are tensioned so that point A does not move. If the tension in the wire AB is 630 lb, determine the vertical force P exerted by the tower on the pin at A.



- 2) A container of weight W is suspended from ring A. Cable BAC passes THROUGH the ring and is attached to fixed supports at B and C. Two forces, $P = P\hat{i}$ and $Q = Q\hat{k}$, are applied to the ring to maintain the container in the position shown. Knowing that $W = 376$ N, determine P and Q.

** Since the single cable BAC passes THROUGH the ring, what does that mean about how the tension in segment BA relates to the tension in segment AC?



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- 3) A single force \mathbf{P} acts at C in a direction perpendicular to the handle BC of the crank shown. Knowing that $M_x = +20 \text{ N}\cdot\text{m}$, $M_y = -8.75 \text{ N}\cdot\text{m}$, and $M_z = -30 \text{ N}\cdot\text{m}$, determine:
- The magnitude of force \mathbf{P}
 - The values of angles θ and ϕ

