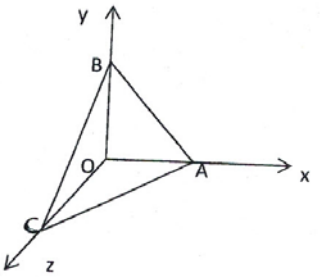
CE 221 ENGINEERING MECHANICS I (FALL 2014 – 2015)
Home Exercise II –Force System Resultants
(http://www2.ce.metu.edu.tr/~ce221)

Q1.

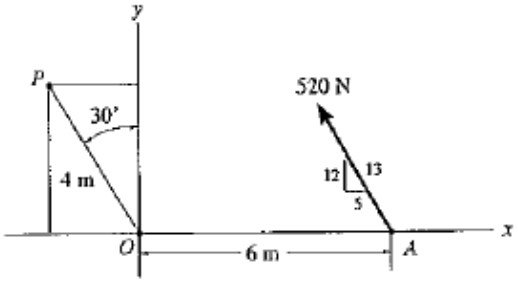
Determine the force vector perpendicular to the plane ABC having a magnitude (D) in kN and passing through point, A. **Note**: OA = 2 m, OB = 4 m, OC = 3 m and the magnitude, D of the force is equal to the last two digits of your student number. If your student number ends with two zeros (0 0), take D = 100 kN.



ANS: F={76.8, 38.4, 51.2}kN for D=100 kN

Q2.

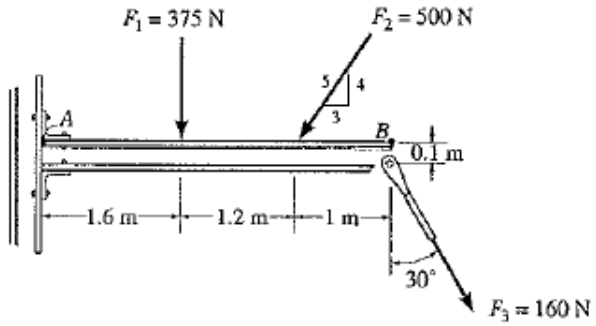
Determine the magnitude and directional sense of the moment of the force at A about point P.



ANS: M_p=3.15 kN.m ↰

Q3.

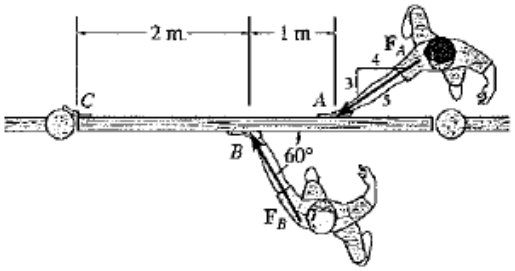
Determine the moment about point B of each of the three forces acting on the beam.



ANS: $(M_{F1})_B$= 825 N.m ↰ , $(M_{F2})_B$= 400 N.m, ↰
$(M_{F3})_B$= 8 N.m ↰

Q4.

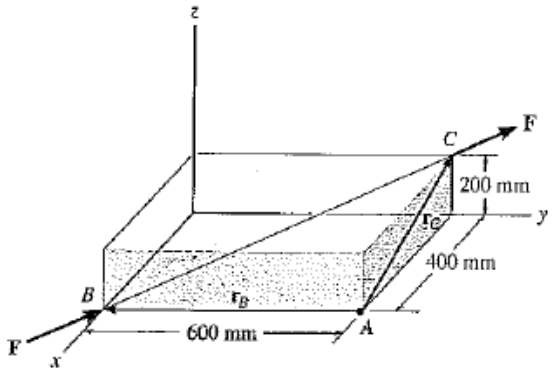
The two boys push on the gate with forces of F_A = 120 N and F_B = 200 N as shown. Determine the moment of each force about C. Which way will the gate rotate, clockwise or counterclockwise? Neglect the thickness of the gate.



ANS: $(M_{FA})_C$=216 N.m, ↘ $(M_{FB})_C$=346.4 N.m, ↰

Q5.

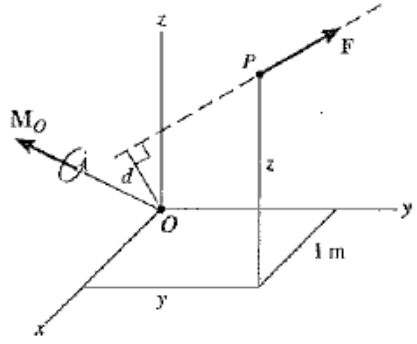
A force **F** having a magnitude of F = 100 N acts along the diagonal of the parallelepiped. Determine the moment of **F** about point A, using $\mathbf{M}_A = \mathbf{r}_B \times \mathbf{F}$ and $\mathbf{M}_A = \mathbf{r}_C \times \mathbf{F}$.



ANS: M_A={-16 i-32.1 k} N.m , M_A={-16 i-32.1 k} N.m

Q6.

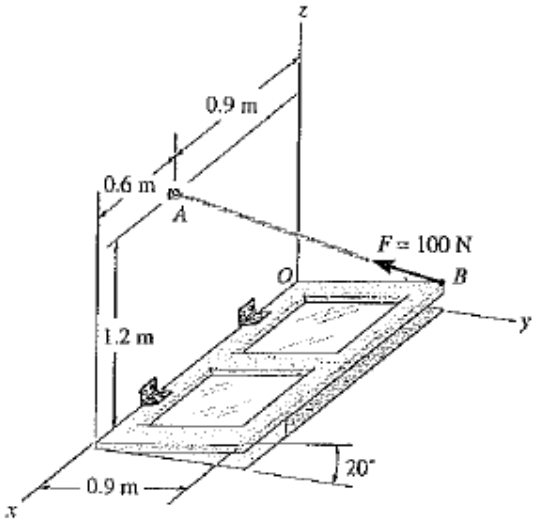
A force of $\mathbf{F} = \{6\mathbf{i} - 2\mathbf{j} + 1\mathbf{k}\}$ kN produces a moment of $\mathbf{M}_O = \{4\mathbf{i} + 5\mathbf{j} - 14\mathbf{k}\}$ kN·m about the origin of coordinates, point O. If the force acts at a point having an x coordinate of x = 1 m, determine the y and z coordinates.



ANS: y= 2 m , z=1 m

Q7.

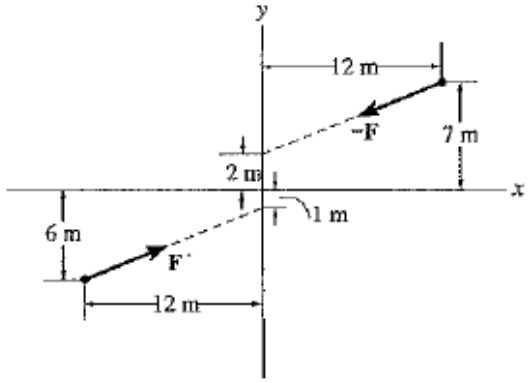
The chain AB exerts a force of 100 N on the door at B. Determine the magnitude of the moment of this force along the hinged axis x of the door.



ANS: M_x=66.6 N.m

Q8.

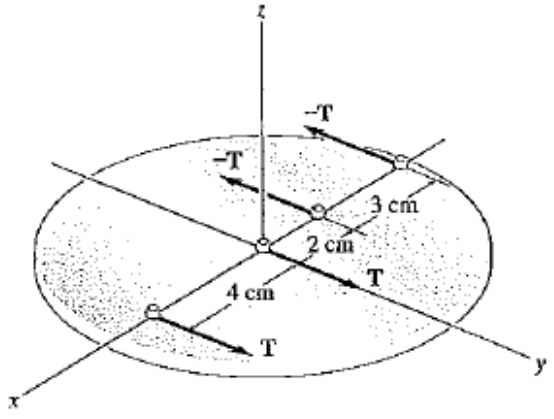
If the couple moment has a magnitude of 300 N · m, determine the magnitude F of the couple forces.



ANS: F=108 N

Q9.

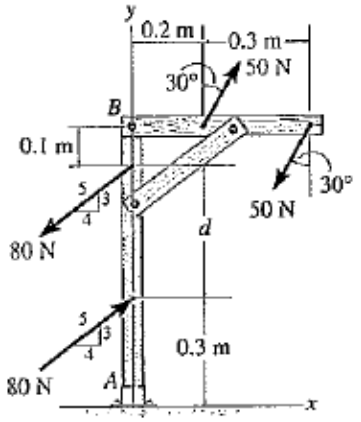
The resultant couple moment created by the two couples acting on the disk is $\mathbf{M}_R = \{10\mathbf{k}\}$ kN · cm. Determine the magnitude of force **T**.



ANS: T=0.909 kN

Q10.

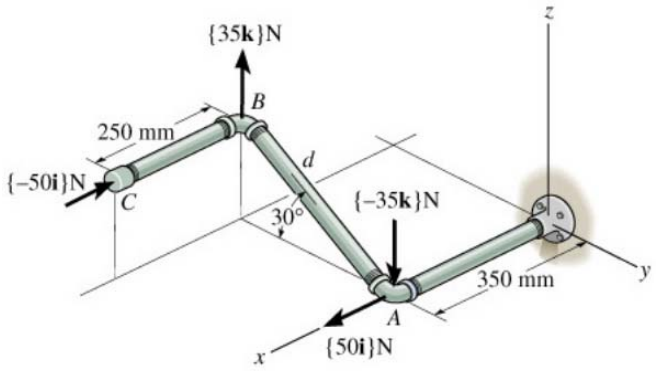
Two couples act on the frame. If the resultant couple moment is to be zero, determine the distance d between the 80-N couple forces.



ANS: d=2.03 m

Q11.

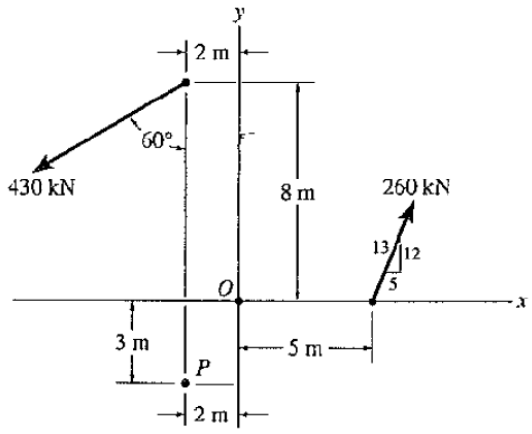
Determine the resultant couple moment of the two couples that act on the pipe assembly. The distance from A to B is d = 400 mm. Express the result as a Cartesian vector.



ANS: M_R={-12.1i-10j-17.3k} N.m

Q12.

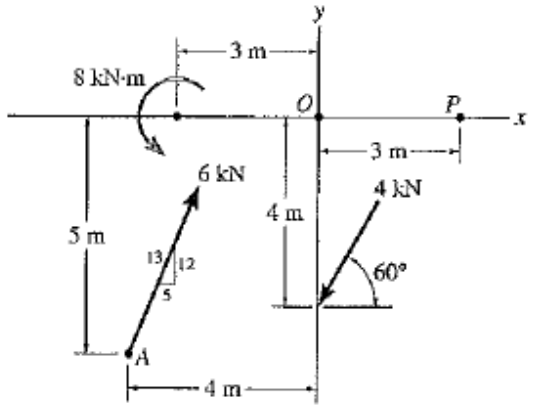
Replace the force system by an equivalent force and couple moment at point O.



ANS: F_R= 274 kN, θ=5.24 ° , M_O=4609 kN.m

Q13.

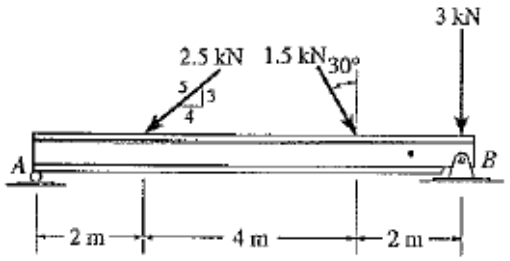
Replace the force and couple system by an equivalent force and couple moment at point O.



ANS: F_R= 2.10 kN, θ=81.6 ° , M_O=10.6 kN.m

Q14.

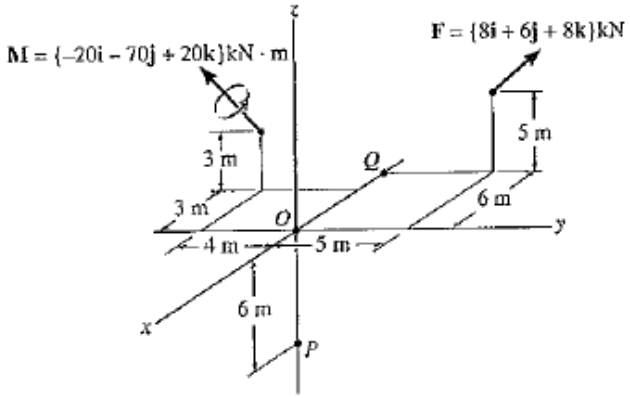
Replace the force system acting on the beam by an equivalent force and couple moment at point A.



ANS: F_R= 5.93 kN, θ=77.8 ° , $(M_R)_A$=34.8 kN.m ↻

Q15.

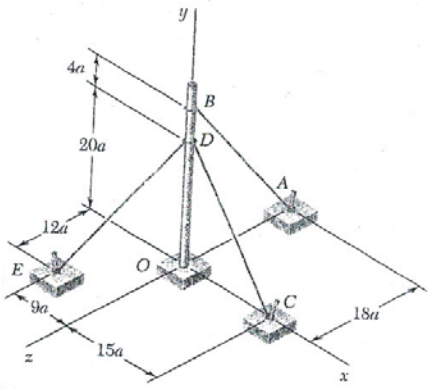
Replace the force and couple-moment system by an equivalent resultant force and couple moment at point P. Express the results in Cartesian vector form.



ANS: F_R= {8i+6j+8k} kN, $(M_R)_P$={-46i+66j-56k} kN.m

Q16.

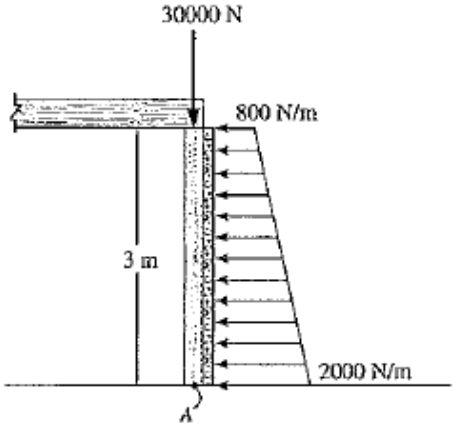
A flagpole is guyed by three cables BA, DC and DE as shown. The tensions in all cables have equal magnitude 20 kN. Determine the equivalent force resultant of the system at point O.



ANS: R={4.8,-48.0,-2.4} kN , M=-96a(1,0,1) kN.m

Q17.

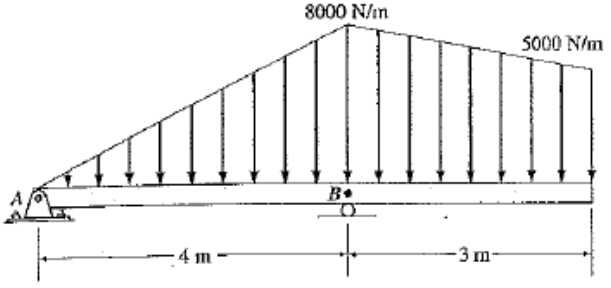
The column is used to support the floor which exerts a force of 30000 N on the top of the column. The effect of soil pressure along its side is distributed as shown. Replace this loading by an equivalent resultant force and specify where it acts along the column, measured from its base A.



ANS: F_R= 32.5 kN, θ=67.2 ° , x=1.286.m

Q18.

Replace the loading by an equivalent resultant force and specify its location on the beam, measured from point B.



ANS: F_R= 35.5 kN, x=0.16.m