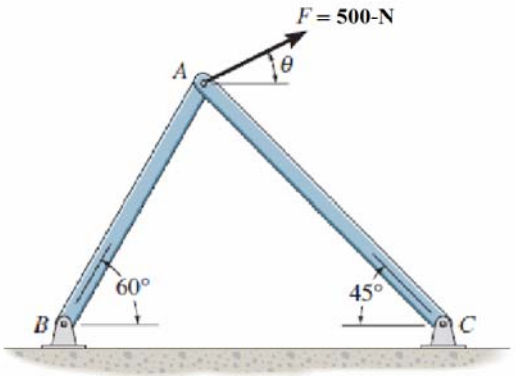
CE 221 ENGINEERING MECHANICS I (FALL 2014 – 2015)
Home Exercise I –Force Vectors
(http://www2.ce.metu.edu.tr/~ce221)

Q1.

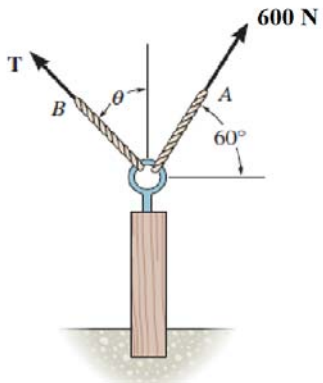
The **500 N** force acting on the frame is to be resolved into two components acting along the axis of the struts AB and AC. If the component of force along AC is required to be **300 N**, directed from A to C, determine the magnitude of force acting along AB and the angle θ of the **500 N** force.



ANS: Φ= 35.42° F_{AB}= 485.11 N

Q2

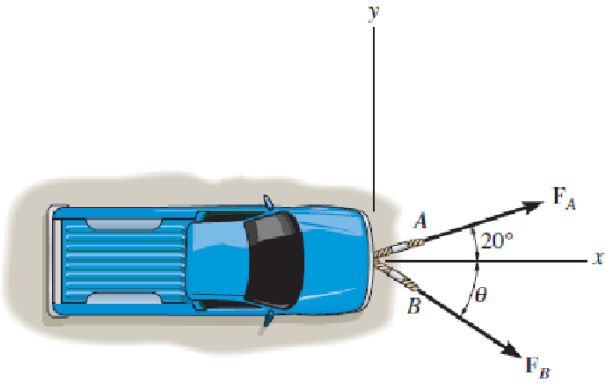
The post is to be pulled out of the ground using two ropes A and B. Rope A is subjected to a force of **600 N** and is directed at 60° from the horizontal. If the resultant force acting on the post is to be **1200 N,** vertically upward, determine the force T in rope B and the corresponding angle θ.



ANS: θ= 23.8° T= 743.6 N

Q3

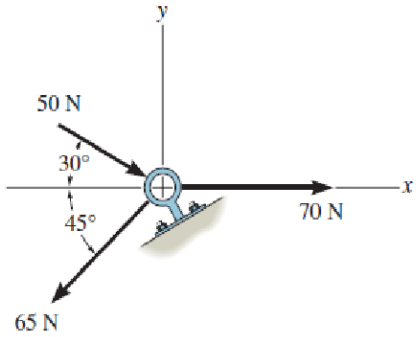
The truck is to be towed using two ropes. If the resultant force is to be 950 N, directed along the positive x axis, determine the magnitudes of forces $\mathbf{F}_A$ and $\mathbf{F}_B$ acting on each rope and the angle of θ of $\mathbf{F}_B$ so that the magnitude of $\mathbf{F}_B$ is a *minimum*. $\mathbf{F}_A$ acts at 20° from the x axis as shown.



ANS: F_A= 892.71 N F_B= 324.92 N

Q4.

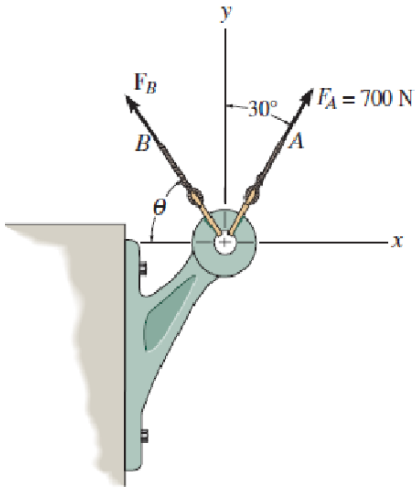
Determine the magnitude of the resultant force and its direction, measured clockwise from the positive x axis.



ANS: FR= 97.8 N θ= 46.5°

Q5.

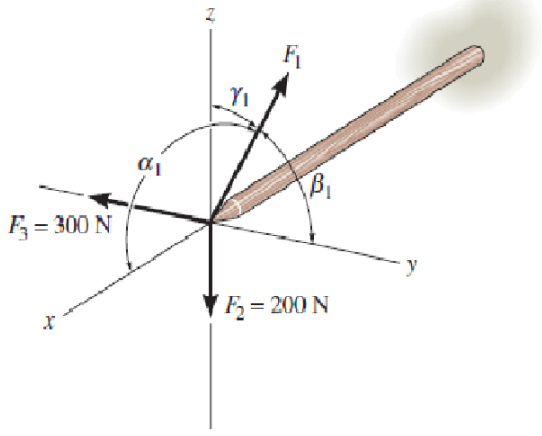
Determine the magnitude and orientation θ of $\mathbf{F}_B$ so that the resultant force is directed along the positive y axis and has a magnitude of 1500 N.



ANS: θ= 68.6° F_B= 960 N

Q6.

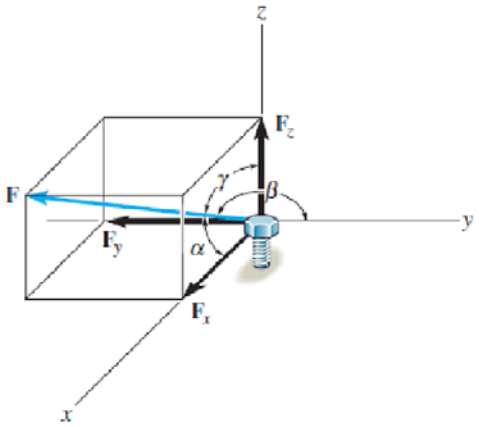
The mast is subjected to the three forces shown. Determine the coordinate direction angles α_1, β_1, γ_1 of $\mathbf{F}_1$ so that the resultant force acting on the mast is zero.



ANS: α_1= 90° β_1= 33.7° γ_1= 56.3°

Q7.

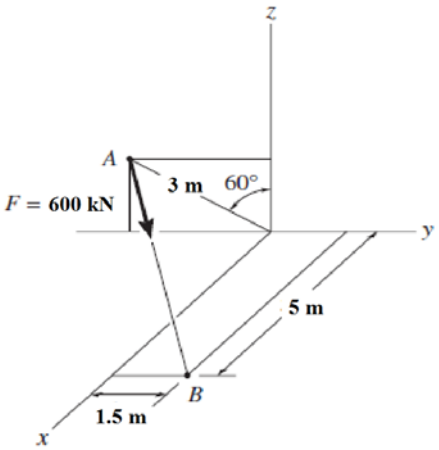
The bolt is subjected to the force $\mathbf{F}$, which has components acting along the x, y, z axes as shown. If the magnitude of $\mathbf{F}$ is 80 N, and $\alpha = 60°$ and $\gamma = 45°$, determine the magnitudes of its components.



ANS: F_x= 40 N F_y= 40 N F_z= 56.6 N

Q8.

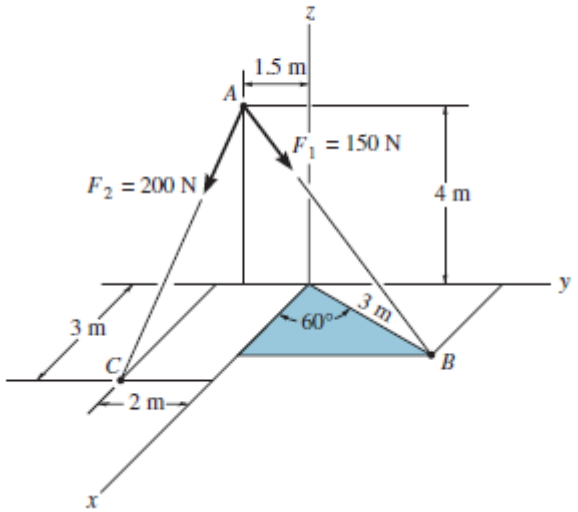
Express force $\mathbf{F}$ as a Cartesian vector; then determine its coordinate direction angles.



ANS: 451.8i + 370.2j -135.6k kN α=41.2°
β=51.9° γ=103°

Q9.

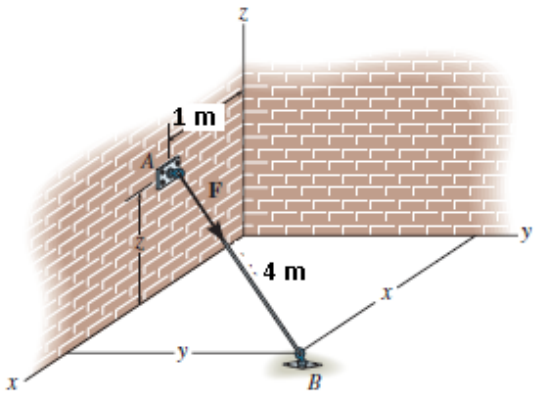
Determine the magnitude and coordinate direction angles of the resultant force acting at point A.



ANS: F_R= 316 N α=60.1° β=74.6° γ=146°

Q10

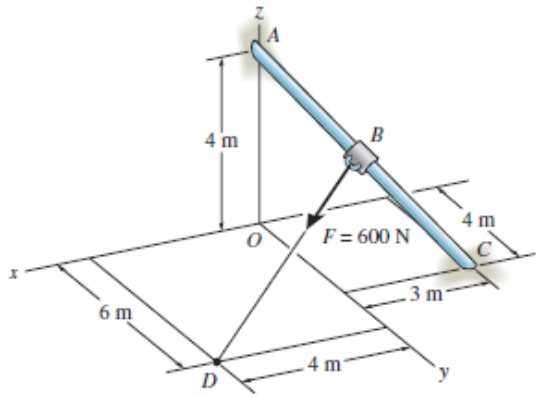
The cord exerts a force of $\mathbf{F} = \{12\mathbf{i} + 9\mathbf{j} - 8\mathbf{k}\}$ **kN** on the hook. If the cord is **4m** long, determine the location x, y of the point of attachment B, and the height z of the hook.



ANS: x= 3.825 m y= 2.12 m z= 1.88 m

Q11.

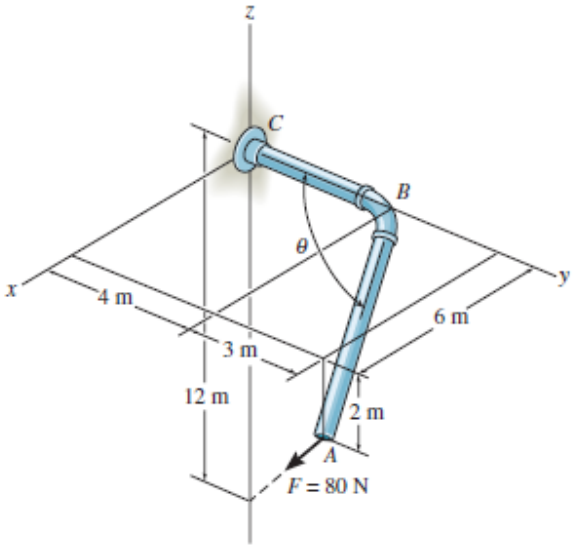
Determine the components of $\mathbf{F}$ that act along rod AC and perpendicular to it. Point B is located at the midpoint of the rod.



ANS: $F_{parallel}$= 99 N $F_{perpendicular}$= 592 N

Q12.

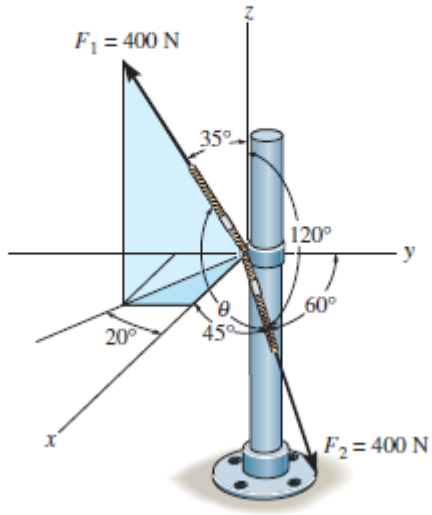
Determine the projected component of the 80-N force acting along the axis AB of the pipe.



ANS: F= 31.1 N

Q13.

The cables each exert a force of 400 N on the post. Determine the magnitude of the projected component of $\mathbf{F}_1$ along the line of action of $\mathbf{F}_2$.



ANS: $F1_{F1}$= 50.6 N

Q14.

Cable AB is 31 m long, and the tension in that cable is equal to the last two digits of your student number. If your student number ends with two zeros (0 0), take this tension as 100 kN. Determine:

a) The x, y and z components of the force exerted by the cable AB on anchor B,

b) The angles θ_x , θ_y , θ_z defining the direction of that force (direction cosines).