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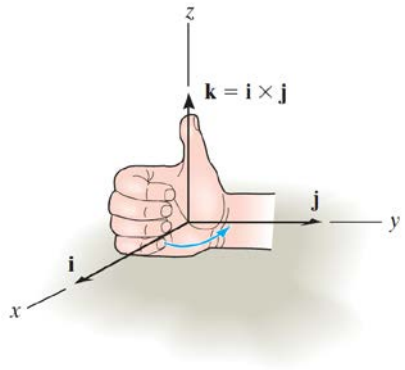
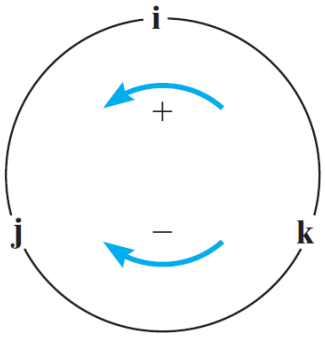
ENGR 057 Statics and Dynamics

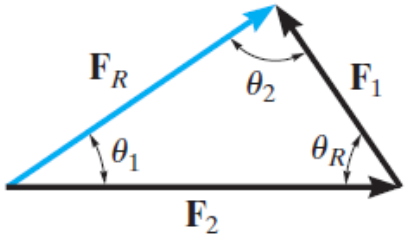
First exam. Summer 2022

Write your name on all pages. You may use a calculator. To receive full credit, you must show a complete FBD and steps to solving the problems in addition to the correct final answer. Use three significant figures in your final answers.

$$\mathbf{A}\times\mathbf{B}=\begin{vmatrix}\hat{\mathbf{i}} & \hat{\mathbf{j}} & \hat{\mathbf{k}}\\ A_x & A_y & A_z\\ B_x & B_y & B_z\end{vmatrix}=\hat{\mathbf{i}}(A_yB_z-A_zB_y)-\hat{\mathbf{j}}(A_xB_z-A_zB_x)+\hat{\mathbf{k}}(A_xB_y-A_yB_x)$$







$$F_R=\sqrt{F_1^2+F_2^2-2F_1F_2\cos\theta_R}$$

$$\frac{F_1}{\sin\theta_1}=\frac{F_2}{\sin\theta_2}=\frac{F_R}{\sin\theta_R}$$

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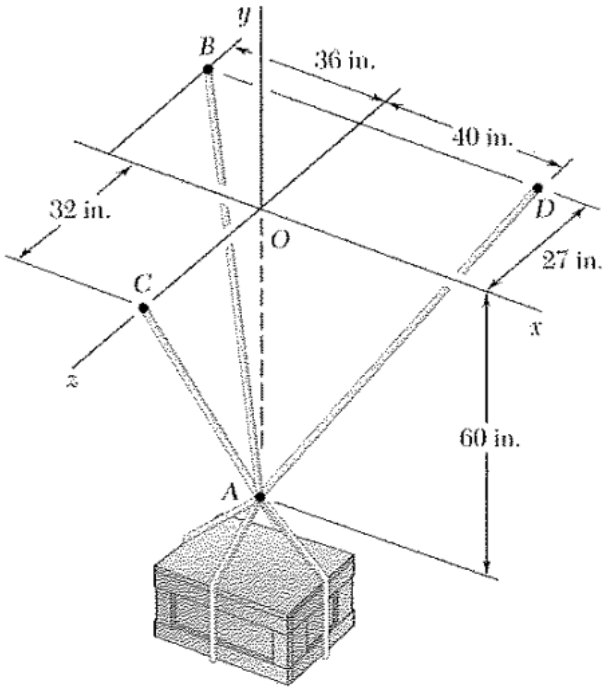
Problem 1 (25 pts)

A crate is supported by three cables as shown. Draw a free body diagram and determine the weight of the crate knowing that the tension in cable *AB* is 750 lb.

HINT: Begin by drawing the FBD and find the position vector of each force.



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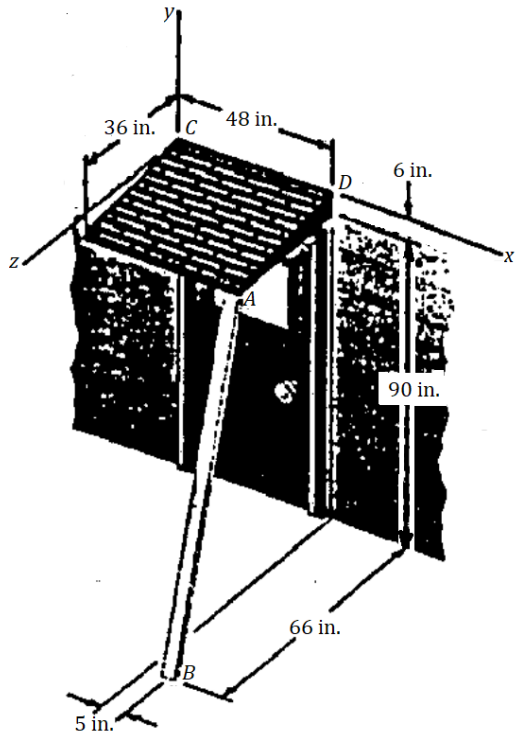
Problem 2 (25 pts)

The roof is supported by the beam *AB* as shown. The load in the beam is 57 lb. Determine the moment of the force of the beam around the point *C*.

HINT: Note that the position vector in the direction of the load $\mathbf{F_{BA}}$ is given by (-5**i** + 90**j** -30**k**).



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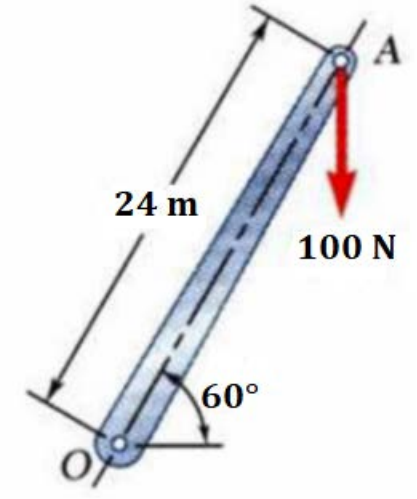
Problem 3 (24 pts)

A 100-lb vertical force is applied to the end of a lever which is attached to a shaft at O.

Determine:
a) moment about O,
b) horizontal force at A which would create the same moment,
c) smallest force at A which would produce the same moment,
d) location for a 240-lb vertical force to produce the same moment.



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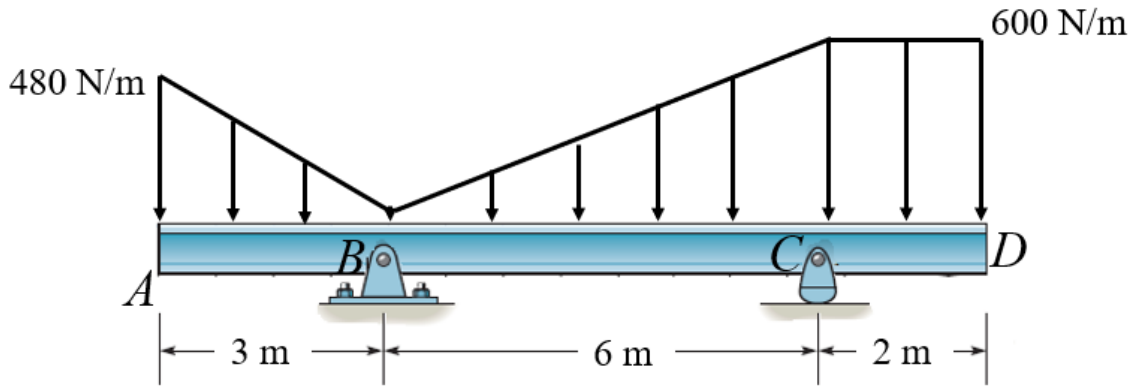
Problem 4 (26 pts)

Replace this loading by an equivalent resultant force and specify its location, measured from point *B*.



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Bonus problem (12 pts)

The 300 lb force is to be resolved into components along lines *a-a'* and *b-b'*. Using trigonometry (law of sine or cosine), determine:

a) The angle α knowing that the component along line *a-a'* is 240 lb.
b) The value of the component *b-b'*.