

CONCORDIA UNIVERSITY
Faculty of Engineering and Computer Science

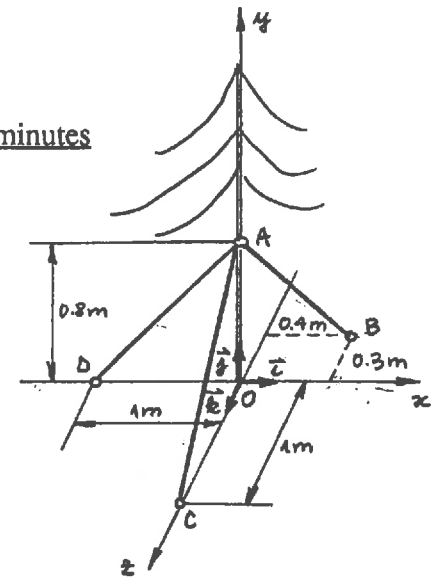
ENGR 242/2 STATICS, Section V
TEST #1

Attempt all questions, only calculators permitted.

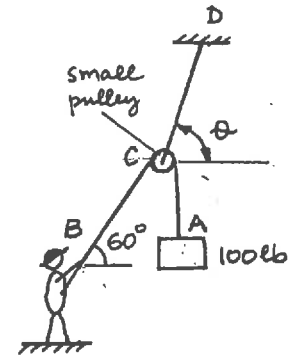
Time: 70 minutes

MARKS

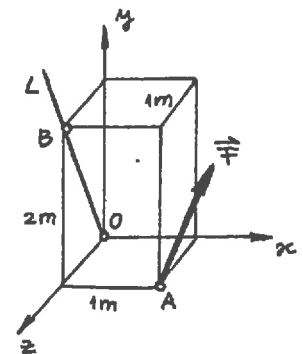
35 ~~1~~ A newly planted tree is secured against the wind by three cables, as shown. The magnitude T_{AB} of the tension in cable AB is 40 N. Calculate the rectangular components of T_{AB} ; then determine the magnitudes T_{AC} and T_{AD} of the tensions in cables AC and AD such that the line of action of the resultant force R acting on the tree at A is along the y axis. Also, determine the magnitude R and write the analytical expression of R .



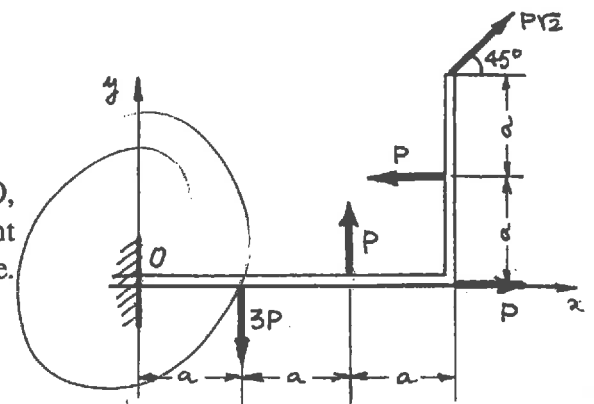
15 ~~2~~ A 100 lb crate is held in equilibrium by a man pulling on the rope ACB at B, as shown. Determine the tension in the rope CD and the angle θ .



20 ~~3~~ A force $F = (200 i + 200 j - 100 k)$ N is acting at point A, as shown. Determine the moment M_{OL} of the force about axis OL which passes through O and point B.

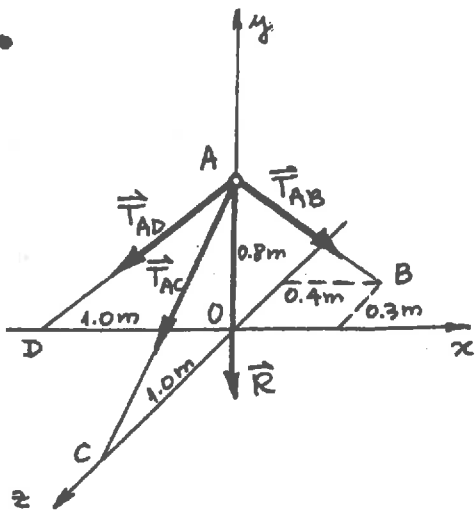


30 4. Determine the equivalent force-couple system at point O, consisting of the resultant force R and the resultant moment M_O , if all the forces acting on the beam are in the xy-plane. Indicate R and M_O on the figure.



ENGR 242/2 - V TEST #1 - SOLUTIONS

1.



$$d(AB) = \sqrt{0.4^2 + 0.8^2 + 0.3^2} = 0.94 \text{ m} \quad d(AC) = d(AD) = \sqrt{0.8^2 + 1.0^2} = 1.28 \text{ m}$$

$$\vec{T}_{AB} = \frac{40}{0.94} (0.4\vec{i} - 0.8\vec{j} - 0.3\vec{k}) = \underline{17.02\vec{i} - 34.04\vec{j} - 12.77\vec{k}} \quad (10)$$

$$\vec{T}_{AC} = \frac{T_{AC}}{1.28} (-0.8\vec{j} + \vec{k}) \quad \vec{T}_{AD} = \frac{T_{AD}}{1.28} (-\vec{i} - 0.8\vec{j})$$

$$R_x = \sum F_x = 0 \quad 17.02 - 0.781 T_{AD} = 0 \Rightarrow \underline{T_{AD} = 21.79 \text{ N}} \quad (10)$$

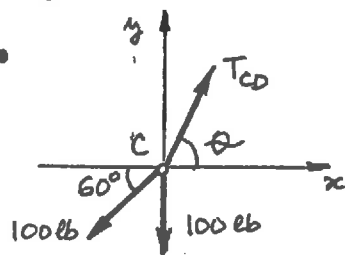
$$R_z = \sum F_z = 0 \quad -12.72 + 0.781 T_{AC} = 0 \Rightarrow \underline{T_{AC} = 16.35 \text{ N}} \quad (10)$$

$$R_y = \sum F_y = -34.04 - (0.625)(16.35) - 0.625(21.79) = -57.88 \text{ N}$$

$$\downarrow \underline{R = 57.88 \text{ N}} \quad \underline{\vec{R} = -57.88 \vec{j} \text{ N}} \quad (5)$$

Σ 35

2.



$$\sum F_x = 0; \quad T_{CD} \cos \theta - 100 \frac{1}{2} = 0$$

$$T_{CD} \cos \theta = 50$$

$$\sum F_y = 0; \quad T_{CD} \sin \theta - 100 - 100 \frac{\sqrt{3}}{2} = 0$$

$$T_{CD} \sin \theta = 186.6$$

$$\tan \theta = 3.732$$

$$\underline{\theta = 75^\circ}$$

$$\underline{T_{CD} = 193.19 \text{ lb}}$$

7.5
7.5
Σ 15

3.

$$\vec{\lambda}(OL) = \frac{\vec{OB}}{OB} = \frac{0\vec{i} + 2\vec{j} + \vec{k}}{\sqrt{5}} = \frac{2}{\sqrt{5}}\vec{j} + \frac{1}{\sqrt{5}}\vec{k} \quad (10)$$

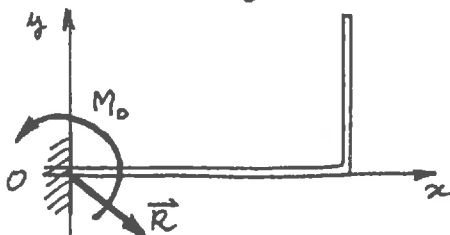
$$M_{OL} = \begin{vmatrix} 0 & \frac{2}{\sqrt{5}} & \frac{1}{\sqrt{5}} \\ 1 & 0 & 1 \\ 200 & 200 & -100 \end{vmatrix} = \underline{357.77 \text{ Nm}} \quad (10)$$

Σ 20

4.

$$\left. \begin{aligned} R_x = \sum F_x = P \\ R_y = \sum F_y = -P \end{aligned} \right\} \Rightarrow \underline{\vec{R} = P\vec{i} - P\vec{j}} \quad \underline{R = 1.41 P} \quad (5)$$

$$M_o = \sum M_o = -(3P)a + P(2a) + P(a) + P(3a) - P(2a) = \underline{Pa} \quad \underline{\vec{M}_o = Pa\vec{k}} \quad (20)$$



5
Σ 30

Total 100