MCG 3130

DGD 4

OCTOBER 3, 2014

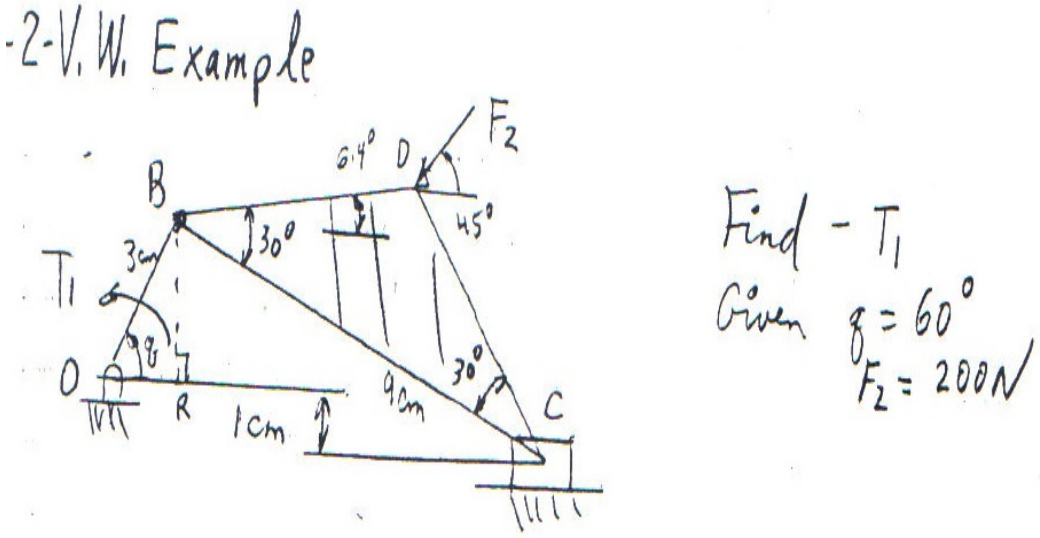
Pls Note:

First Question is the **BOARD PROBLEM QUESTION**
(**VIRTUAL WORK**)

Second question, will be the **ASSIGNED QUESTIONS** To **Students**

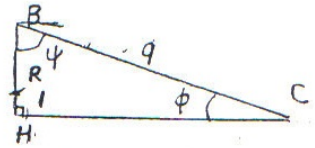
(Vector statics)

Question 1: Board Problem: Using Virtual Work Principle



SOLUTION:

Position



$\sin\phi = \frac{3\sin 60 + 1}{9} = \frac{3.598}{9} = 0.4$

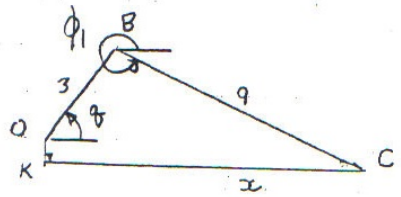
$\phi = 23.6°$

$\psi = 66.4°$

$HC = 9\cos\phi = 8.247$

$OR = 3\cos 60° = 1.5$

$x = 9.747$



Position

$3\cos\theta + 9\cos\phi_1 - x = 0$

$3\sin\theta + 9\sin\phi_1 + KO = 0$

Inverse Diff wrt time

$-9\sin\phi_1\,\dot{\phi}_1 - \dot{x} = 3\sin\theta\,\dot{\theta}$

$9\cos\phi_1\,\dot{\phi}_1 = -3\cos\theta\,\dot{\theta}$

$3.60\,\dot{\phi}_1 - \dot{x} = 2.598\,\dot{\theta}$

$8.25\,\dot{\phi}_1 = -1.5\,\dot{\theta}$

$\theta = 60°$

$\phi_1 = 360° - 23.6° = 336.4°$

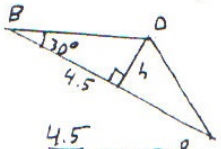
$\dot{\phi}_1 = -\frac{1.5}{8.25}\dot{\theta} = -0.182\,\dot{\theta}$

$\dot{x} = [3.6(-.182) - 2.598]\dot{\theta} = -3.25\,\dot{\theta}$

Forward

$x_D = 3\cos\theta + 5.196\cos(\phi_1 + 30°)$

$y_D = 3\sin\theta + 5.196\sin(\phi_1 + 30°)$



$\frac{4.5}{BD} = \cos 30° =$

$BD = \frac{4.5}{.866} = 5.196$

$\dot{x}_D = -3\sin\theta\,\dot{\theta} - 5.196\sin(\phi_1 + 30°)\,\dot{\phi}_1 = [-2.598 - 0.579\times(-.182)]\dot{\theta}$ (−2.49)

$\dot{y}_D = -3\cos\theta\,\dot{\theta} + 5.196\cos(\phi + 30°)\,\dot{\phi}_1 = [1.5 + 5.164\times(-.182)]\dot{\theta}$ (0.560)

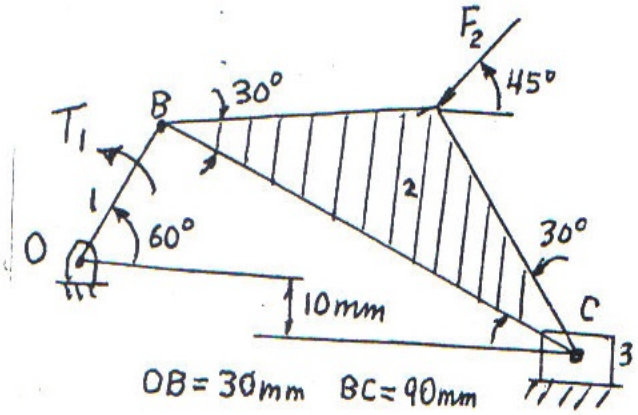
VW Eqn $\sum \underset{\sim}{F}_m \cdot \underset{\sim}{V}_m + \sum \underset{\sim}{T}_n \cdot \underset{\sim}{\omega}_n = 0$

$(-200\cos 45°\,\underset{\sim}{i} - 200\sin 45°\,\underset{\sim}{j}) \cdot (-2.49\,\underset{\sim}{i} + 0.560\,\underset{\sim}{j}) + T_1\,\underset{\sim}{k} \cdot \dot{\theta}\,\underset{\sim}{k} = 0$

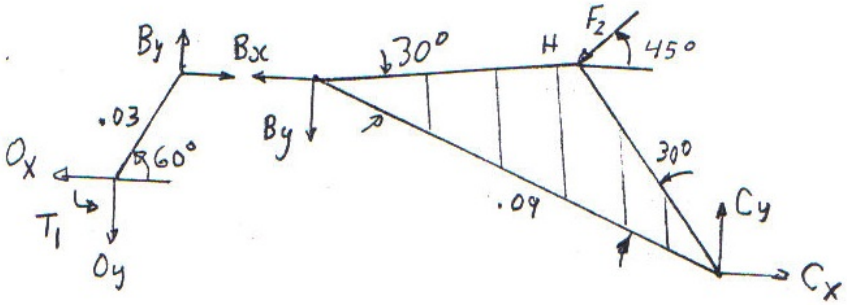
$T_1 = -279.9$ N/...

Question 2: Assigned Problem: Using Vector static method.

Determine the required input torque T_1 for static equilibrium of the mechanism shown. Force F_2 has a magnitude of 200N.



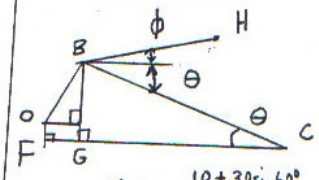
SOLN:



$F_z = 200\ N$

$F_x = F_y = 200/\sqrt{2} = 141.4$

Geometry



$\sin\theta = \frac{10 + 30\sin 60°}{90} = 0.4$

$\theta = 23.56° \approx 24°$ $\quad \phi = 30° - \theta = 6°$

$\frac{.045}{BH} = \cos 30°$

$BH = 0.052\ m$

$C_x = 0$ no friction

Member BC $\quad \Sigma F_x = 0 \quad -B_x - F_x = 0$

$\Sigma F_y = 0 \quad C_y - B_y - F_y = 0$

$\circlearrowleft \Sigma M_B = 0 \quad .09\cos 24° C_y + BH \sin 6° F_x - BH \cos 6° F_y = 0$

$C_y = 79.5\ N \quad B_x = -141.4\ N \quad B_y = -61.8\ N$

Member OB $\quad T_1 - .03\sin 60° B_x + .03\cos 60\, B_y = 0 \quad T_1 = -2.75\ Nm$