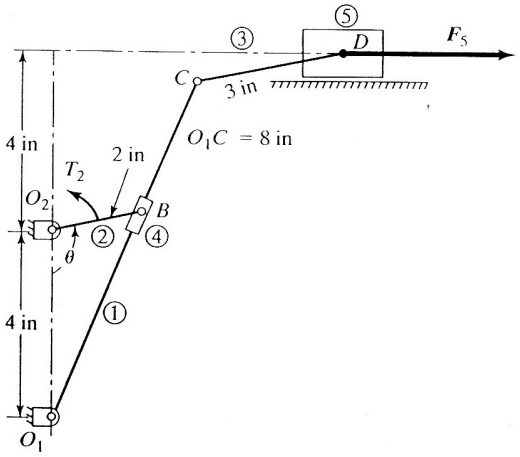
MCG 3130 DGD Static Analysis of Mechanisms 24th October, 2014.

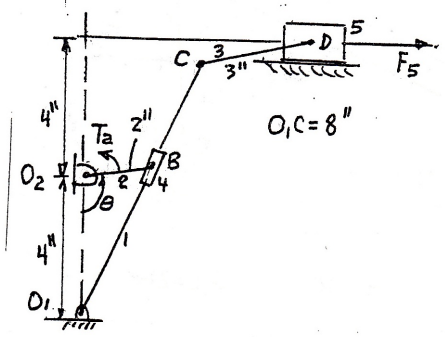
Board question:

3. Determine the required input torque T_2 for static equilibrium of the quick-return mechanism shown in Figure P9.11. Force F_5 on the slider has a magnitude of 800 lb. Angle θ equals 105°.

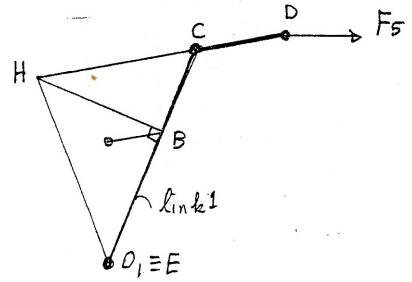


IV-4

Determine the required input torque T_2 for static equilibrium of the quick return mechanism. Force F_5 on the slider has a magnitude of 800 lb. $\theta = 105°$.



SOLN:



Member CD - two forces - along CD

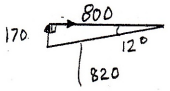
Force on O_1C, ie on link 1 at B is $\perp$ to link

Member O_1C has three forces - concurrent at H

By measurement - BH is 157° wrt +ve horizontal

$\angle O_2O_1C = 23°$ $\angle O_1O_2B = 105°$

Link 3

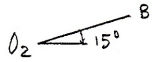


$F_5 = 800$ lb

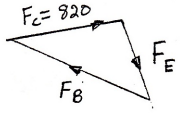
$F_{cy} = 800 \tan 12°$

$= 170$ lb

Link 2



Link 1 Forces

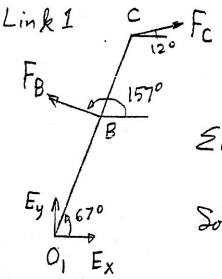


Write three eqns for link 1

$E_x + F_B \cos 157° + F_C \cos 12° = 0$

$E_y + F_B \sin 157° + F_C \sin 12° = 0$

Link 1



$\Sigma M_{O_1} = 0 \quad -(F_B \cos 157°)(5 \sin 67°) + (F_B \sin 157°)(5 \cos 67°)$ (4.60, 1.95)

$- F_{Cx}(8 \sin 67°) + F_{Cy}(8 \cos 67°) = 0$ (7.36, 3.13)

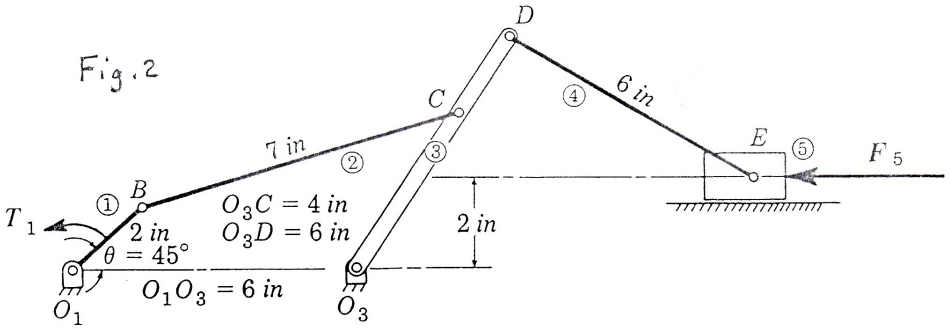
Solve $F_B = 1072$ lb $\quad E_x = +187$ lb $\quad E_y = -589$ lb

Link 2 $\quad T_2 + F_{Bx}(2 \sin 15°) - F_{By}(2 \cos 15°) = 0 \quad T_2 = 1320$ lb-in

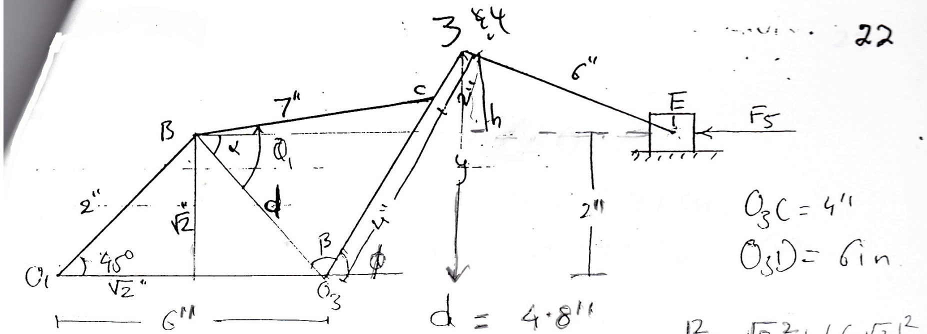
Assigned Problems: **MCG 3130**

Q2:

2. Determine the required input torque T_1 for static equilibrium of the mechanism shown in Figure 2.
The force F_5 on the slider has a magnitude of 1000 lb.



Solutions:



$O_3C = 4"$

$O_3D = 6\text{ in}$

$d = 4.8"$

$d^2 = \sqrt{2}^2 + (6-\sqrt{2})^2$

By cosine law.

$7^2 = 4.8^2 + 4^2 - 38.4\cos\beta$

$\beta = 105.03°$

$\frac{\sin\theta_1}{4} = \frac{\sin\beta}{7}$ $\quad\quad$ $\tan\alpha = \frac{\sqrt{2}}{6-\sqrt{2}}$

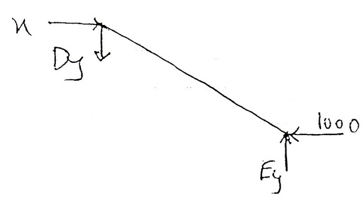
$\theta_1 = 33.5°$ $\quad\quad$ $\alpha = 17.14°$

$\phi = 180 - (\beta + \alpha) = 57.8°$

$y = 6\sin 57.8 = \underline{5.08}$; $h = y - 2 = \underline{3.08}$

$E_x = F_5 = 1000\,lb$

<u>Link 4</u>



$\Sigma M_D = 0.$

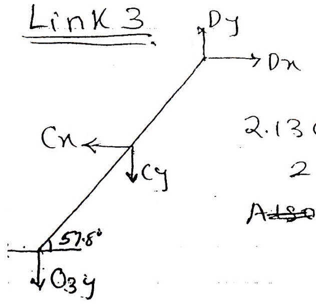
$-1000(3.08) + 5.15E_y = 0$

$E_y = D_y = 598.2N$

$\Sigma F_x = 0$

$D_x = -1000\,lb.$

<u>Link 3</u>



$\Sigma M_{O_3} = 0$

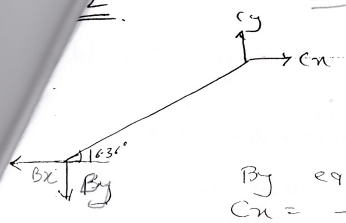
$2.13C_y = 3.39C_x + 5.08(1000) + 3.19(598.2)$

$2.13C_y = 3.39C_x + 6988.13$ —(1).

~~Also~~

Link 2

2.



$\Sigma M_B = 0$

$6.72 C_y = 1.97 C_x$.

$C_y = 0.293 C_x$ — (2).

By eqn (1) & (2).

$C_x = -2526.8$ lb

$C_y = -740.4$ lb.

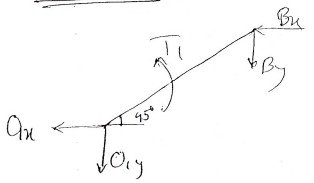
$\Sigma F_x = 0$.

$B_x = -2526.8$ lb

$\Sigma F_y = 0$

$B_y = -740.4$ lb.

Link 1



$\Sigma M_{O_1} = 0$.

$T_1 = -2526.8(\sqrt{2}) + 740.7(\sqrt{2})$

$= 2525.9$ in-lb ↺