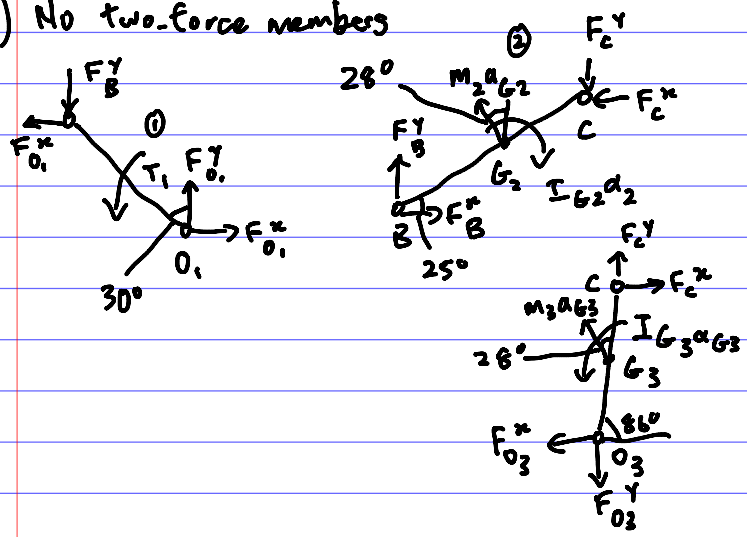
1) No two-force members



Taking moments about O_3:

$$40\times10^{-3} F_C^Y \sin 4^\circ - 40\times10^{-3} F_C^X \cos 4^\circ + \sin 28^\circ m_3 a_{G_3} O_3 G_3 + I_{G_3}\alpha_{G_3} = 0$$

$$0.04\sin 4^\circ F_C^Y - 0.04\cos 4^\circ F_C^X + 0.65(292)\sin 28^\circ \times 20\times10^{-3} + 200\times10^{-6}(6940) = 0$$

$$2.79025895\times10^{-3} F_C^Y - 0.039902562 01 F_C^X + 3.170114052 = 0$$

$$2.79025895\times10^{-3} F_C^Y - 0.039902562 01 F_C^X = -3.170114052 \quad -(1)$$

$\sum F_x = 0$:

$$F_C^X - F_{O_3}^X - 0.65(292)\sin(28-4) = 0$$

$$F_C^X - F_{O_3}^X = 77.19861486 \quad -(2)$$

$\sum F_y = 0$:

$$F_C^Y - F_{O_3}^Y + 0.65(292)\cos(28-4) = 0$$

$$F_C^Y - F_{O_3}^Y = -173.3909279 \quad -(3)$$

1) Taking moments about B:

$$F_C^x \sin 25° \times 80\times10^{-3} - F_C^y \cos 25° \times 80\times10^{-3} + m_2 a_{G2} \cos(28° - 25°) \times 40\times10^{-3} - I_{G2}\alpha_{G2} = 0$$

$$0.033809460946 F_C^x - 0.072504622946 F_C^y + 0.78(690)\cos 3° \times 40\times10^{-3} - 3000\times10^{-6}(2670) = 0$$

$$0.033809460946 F_C^x - 0.072504622946 F_C^y + 13.488409662 = 0$$

$$0.033809460946 F_C^x - 0.072504622946 F_C^y = -13.488409662 \quad -(4)$$

$\sum F_y = 0$:

$$F_B^y - F_C^y + m_2 a_{G2} \cos 28° = 0$$

$$F_B^y - F_C^y = -(0.78)(690)\cos 28°$$

$$= -475.2023945 \quad -(5)$$

$\sum F_x = 0$:

$$F_B^x - F_C^x - m_2 a_{G2} \sin 28° = 0$$

$$F_B^x - F_C^x = 0.78(690)\sin 28°$$

$$= 252.6695951 \quad -(6)$$

Solving (1) and (4):

$$F_C^y = 230.6021601 \quad -(7)$$

$$\approx 230.60\ \text{N}$$

$$F_C^x = 95.57165257 \quad -(8)$$

$$\approx 95.57\ \text{N}$$

1) Substituting (7) and (8) into (2), (3), (5), (6):

From (2):

$95.57165257 - F_{D_3}^{x} = 77.19861486$

$F_{D_3}^{x} = 18.37303771$

$\approx 18.37\,N$

From (3):

$F_C^{y} - F_{D_3}^{y} = -173.3909279$

$F_{D_3}^{y} = 403.993088$

$\approx 403.99\,N$

From (5):

$F_B^{y} - F_C^{y} = -475.2023945$

$F_B^{y} = -244.6102344$

$\approx -244.61\,N$

From (6):

$F_B^{x} - F_C^{x} = 252.6895951$

$F_B^{x} = 348.2412477$

$\approx 348.24\,N$

1) Taking moments about O_1:

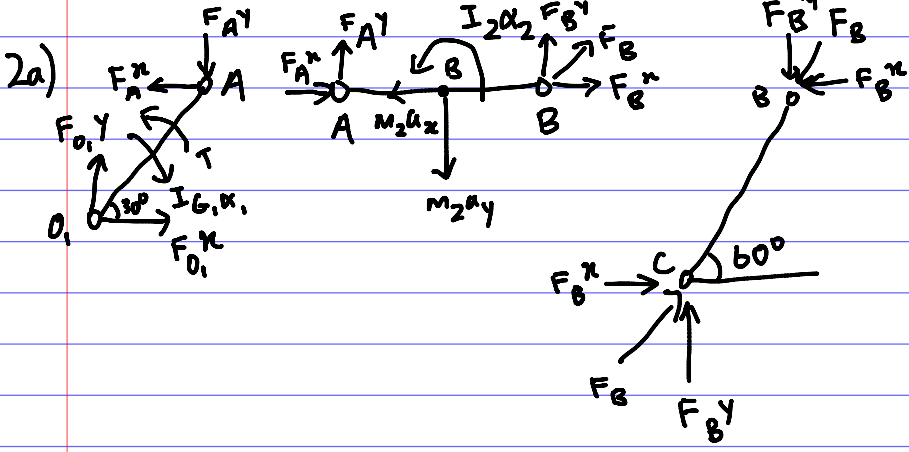
$$F_B^x \cos 30° \times 20\times10^{-3} + F_B^y \sin 30° \times 20\times10^{-3} + T_1 = 0$$

$$-T_1 = 348.2412477 \cos 30° \times 20\times10^{-3} - 244.6102344 \sin 30° \times 20\times10^{-3}$$

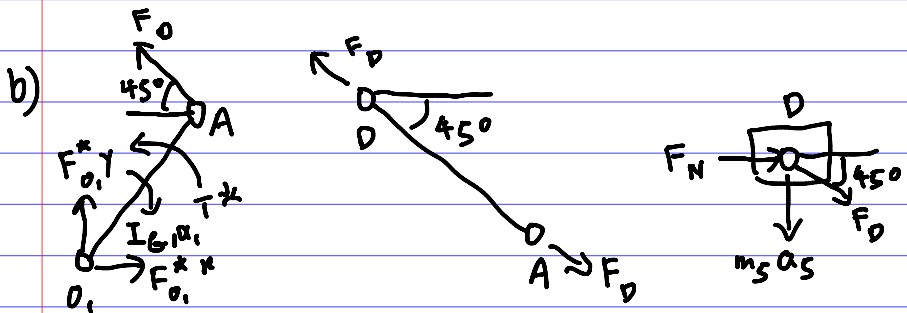
$$T_1 = -3.585612999$$

$$\approx -3.59 \text{ Nm}$$

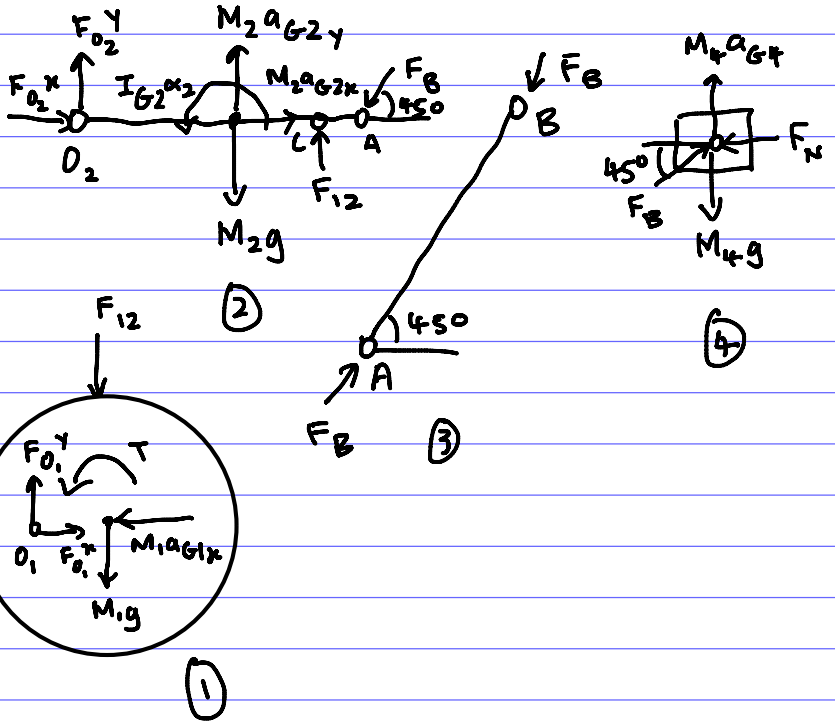
2a)



b)



The extra torque due to links 4 and 5 can be obtained by the method of superposition. The total torque is $T + T^*$.


$F_{O_2}^Y$
$M_2 a_{G2y}$
$F_{O_2}^X$
$I_{G2}\alpha_2$
$M_2 a_{G2x}$
F_B
45°
O_2
C
A
F_{12}
$M_2 g$
2
F_B
B
45°
A
F_B
3
$M_4 a_{G4}$
F_N
45°
F_B
$M_4 g$
4
F_{12}
$F_{O_1}^Y$
T
O_1
$F_{O_1}^X$
$M_1 a_{G1x}$
$M_1 g$
1