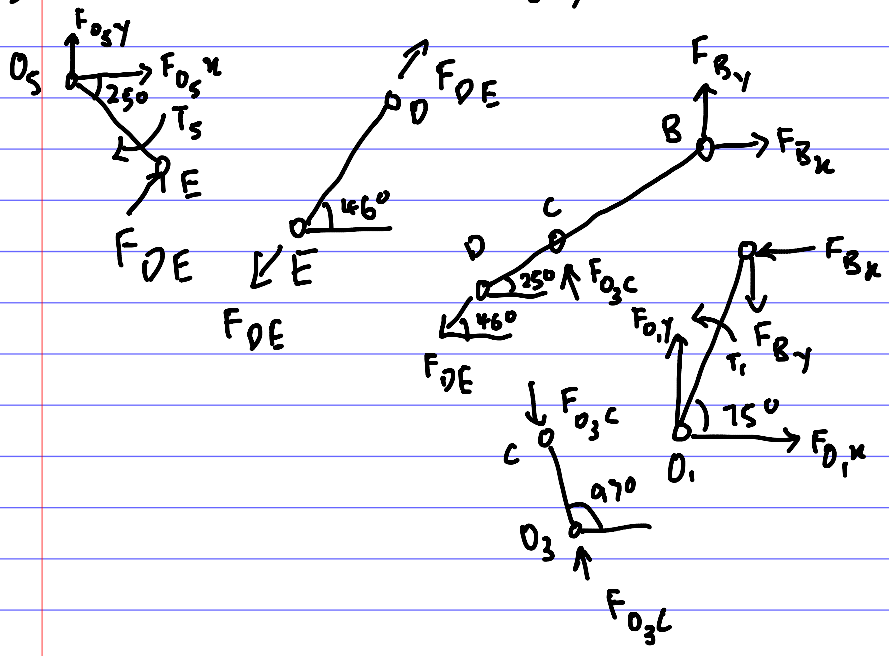
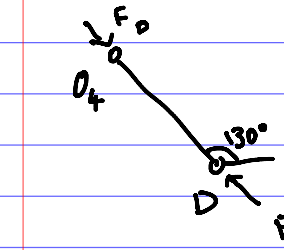
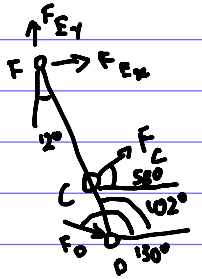
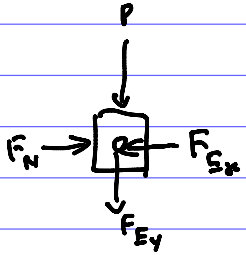
1) Two-force members: O_3C, DE

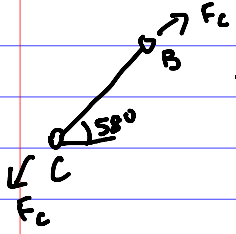


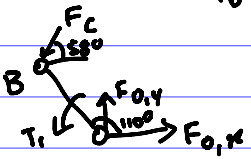
2) Two-force members: O_4D, BC



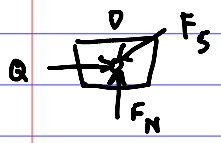


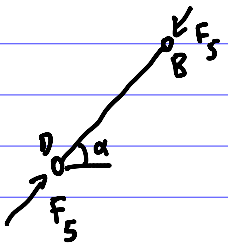


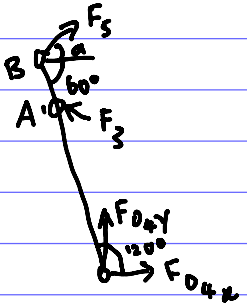


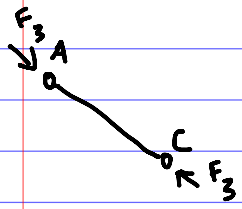


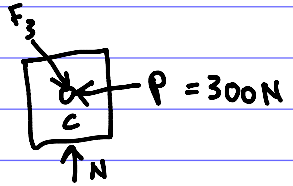
3:) Two-force members: DB, CA



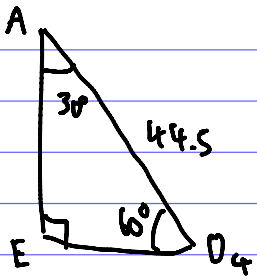


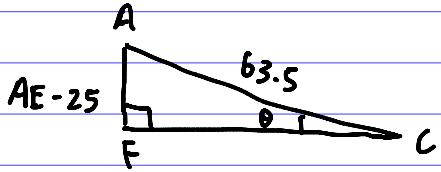






ii)





$AO_4 \cos 30° = AE$

$AE = 44.5 \cos 30°$ mm

$AF = AE - 25$

$= 44.5 \cos 30° - 25$

$= 13.538130 47$

≈ 13.5 mm

3.ii) $\sin\theta = \frac{13.5}{63.5}$

$\theta = 12.30988244$

$\approx 12.3°$

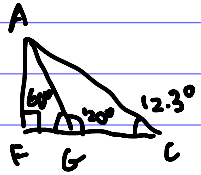
$F_3 \cos\theta = P$

$F_3 = \frac{P}{\cos\theta}$

$= \frac{300}{\cos 12.3°}$

$= 307.0596652$

$\approx 307N$



$\angle GAC = 180 - 120 - 12.3$

$= 47.69011756$

$\approx 47.7°$

Taking moments about O_4:

$O_4A\, F_3 \sin 47.7° = O_4B\, F_5 \sin(\alpha + 60°)$

$44.5(307)\sin 47.7° = 63.5 F_5 \sin(\alpha + 60°)$

$F_5 = \frac{159.1005386}{\sin(\alpha + 60°)}$

3ii) $\sin 60° = \frac{AF}{AG}$

$AG = \frac{AF}{\sin 60°}$

$= \frac{13.5}{\sin 60°}$

$= 15.63248654$

$\approx 15.6 \text{ mm}$

$\frac{\sin\alpha}{BG} = \frac{\sin 60°}{BO}$

$\sin\alpha = \frac{\sin 60°}{76.2}(19 + 15.6)$

$\sin\alpha = 0.393603847$

$\alpha = 23.17892799°$

$\approx 23.18°$

$F_S = \frac{159.1005386}{\sin(23.18+60)}$

$= 160.2346966 \text{N}$

$\approx 160.2 \text{N}$

$Q = F_S \cos\alpha$

$= 160.2 \cos(23.18)$

$= 147.3005775 \text{N}$

$\approx 147 \text{N}$

4a) $C_{AB} = \frac{m(N_1 + N_2)}{2}$

$= \frac{6(20+60)}{2}$

$= 240\ mm$

$C_{BC} = \frac{m(N_2 + N_3)}{2}$

$= \frac{6(60+40)}{2}$

$= 300\ mm$

b) Let CCW be positive.

$n_B = 800\left(-\frac{20}{60}\right)$

$= -\frac{800}{3}$

$\approx 267\ rpm\ CW$

$n_C = -\frac{800}{3}\left(-\frac{60}{40}\right)$

$= 400\ rpm\ CCW$

4c) $P = \omega T = 7.5\text{kW}$

$P = \omega_A T_A$

$7.5 \times 10^3 = \frac{2\pi}{60}(800)\, T_A$

$T_A = 89.52465549$

$\simeq 89.5\text{Nm}$

$T_B = 0\text{Nm}$ (idler)

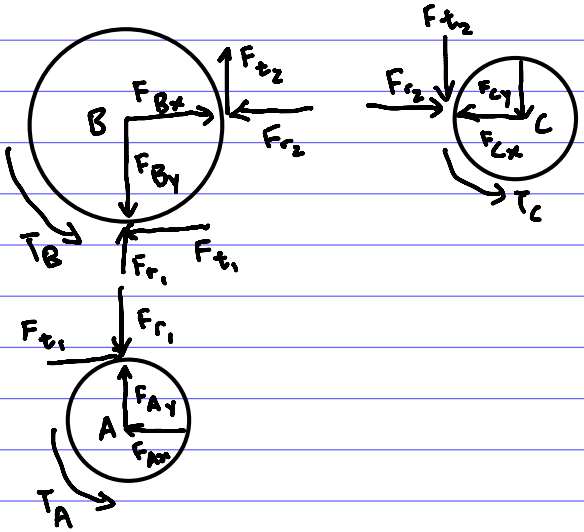
$P = \omega_C T_C$

$7.5 \times 10^3 = \frac{2\pi}{60}(400)\, T_C$

$T_C = 179.0949311$

$\simeq 179\text{Nm}$

4d)



$$F_{t_1} = F_{Ax} = \frac{T_A}{r_A}$$

$$= \frac{T_A}{\frac{mN_1}{2}}$$

$$= \frac{2T_A}{mN_1}$$

$$= \frac{2(89.5)}{6\times10^{-3}(20)}$$

$$= 1492.077592$$

$$\approx 1492N$$

$$F_{r_1} = F_{Ay} = F_{t_1}\tan\beta$$

$$= 1492\tan(20^\circ)$$

$$= 543.0718305$$

$$\approx 543N$$

4d) $F_{t_2} = F_{cy} = \frac{2T_c}{mN_3}$

$= \frac{2(179)}{6\times10^{-3}(40)}$

$= 1492.077592$

$\approx 1492N$

$F_{r_2} = F_{cx} = F_{t_2}\tan\phi$

$= 1492\tan(20°)$

$= 543.0718306$

$\approx 543N$

$F_{Bx} = F_{t_1} + F_{r_2}$

$= 1492 + 543$

$= 2035.079423$

$\approx 2035N$

$F_{By} = F_{r_1} + F_{t_2}$

$= 543 + 1492$

$= 2035.079423$

$\approx 2035N$