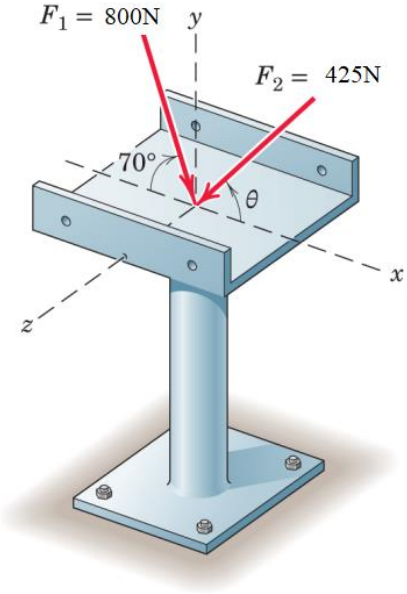
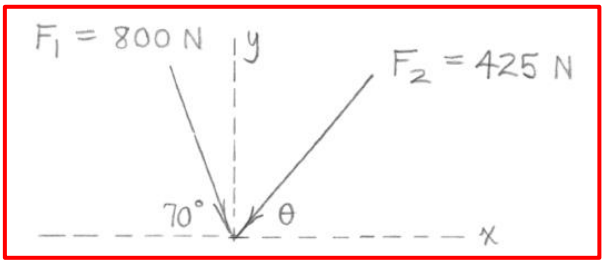
2023-1 Solid Mechanics Quiz #1

(2023.04.11.)

『Please write all the answers on this test sheets. You can also use the back side for the answers.』

1. Two forces are applied to the construction bracket as shown. (a) Determine the angle which makes the resultant of the two forces vertical. (b) Determine the magnitude R of the resultant. [20 Points]





$R_x = \Sigma F_x = 800 \cos 70° - 425 \cos\theta = 0$

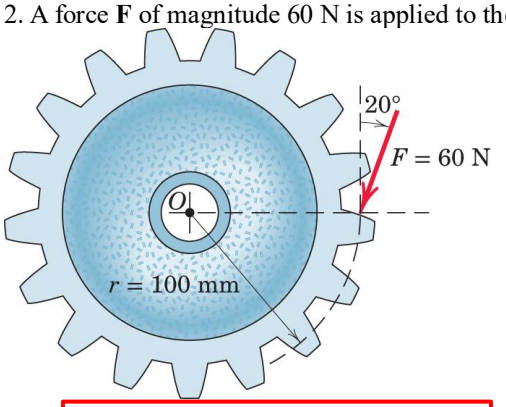
$\theta = 49.9°$

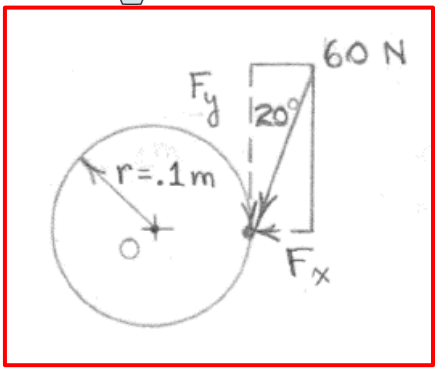
$R_y = \Sigma F_y = -800 \sin 70° - 425 \sin 49.9°$

$= -1077\ N$

So $R = 1077\ N$

2. A force **F** of magnitude 60 N is applied to the gear. Determine the moment of **F** about point O. [10 Points]



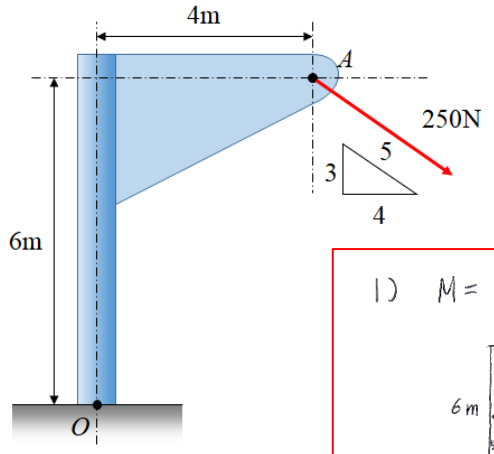


$+\circlearrowleft M_o = r F_y$

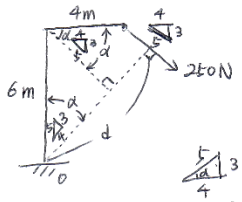
$= (0.1)(60 \cos 20°)$

$= 5.64\ N \cdot m$

3. Calculate the magnitude of the moment about the base point O of the 600-N force in five different ways. [20 Points]



1) $M = Fd$ 이용.



$d = 4\sin\alpha + 6\cos\alpha$

$= 4\left(\frac{3}{5}\right) + 6\left(\frac{4}{5}\right)$

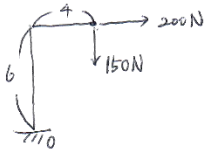
$= \frac{36}{5}\,(m)$

$\therefore M_o = Fd = 250\left(\frac{36}{5}\right)$

$= 1800\,(N\cdot m)$ CW ↻

$\left(\sin\alpha = \frac{3}{5},\ \cos\alpha = \frac{4}{5}\right)$

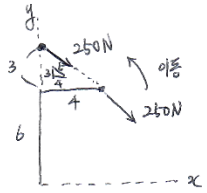
2) 250 N을 F_x와 F_y로나눔.

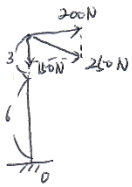


↻ $M_o = 200(6) + 150(4)$

$= 1800\,(N\cdot m)$ CW

3) 250 N을 $x=0$ 위치로 이동.

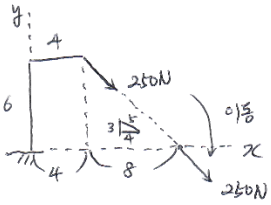


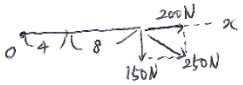


F_x 성분만 모멘트를 생성.

$M_o = 200(9) = 1800\,(N\cdot m)$CW

4) 250 N을 $y=0$ 위치로 이동.





F_y 성분만 모멘트를 생성.

$M_o = 150(12) = 1800\,(N\cdot m)$ CW

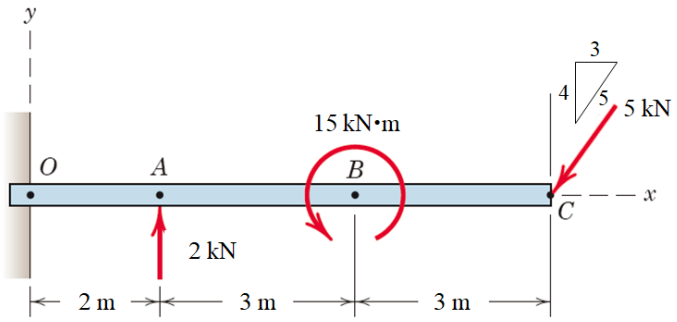
5) $\vec{M} = \vec{r} \times \vec{F}$ 이용.

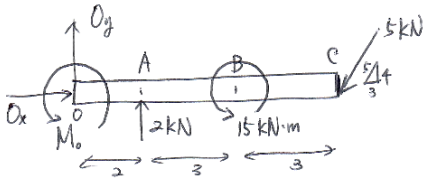
$\vec{M}_o = (4\vec{i} + 6\vec{j}) \times (200\vec{i} - 150\vec{j})$

$= -600\vec{k} - 1200\vec{k} = -1800\vec{k}$

$\therefore M_o = 1800\,(N\cdot m)$ CW

4. Calculate the reaction forces at point O. (Neglect the weight of the beam.) [30 Points]





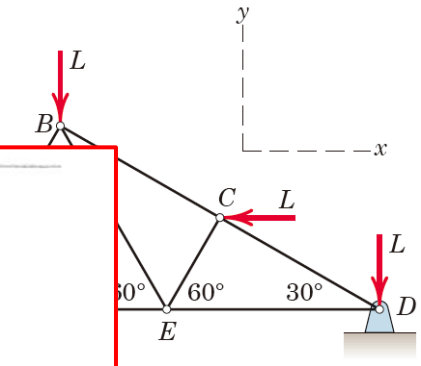
$\Sigma F_x = 0$: $O_x - 3 = 0$ $\therefore O_x = 3\,kN$

$\Sigma F_y = 0$: $O_y + 2 - 4 = 0$ $\therefore O_y = 2\,kN$

$\Sigma M_o = 0$: $M_o + 2(2) + 15 - 8(4) = 0$

$\therefore M_o = 13\ kN\cdot m$

5. A simple asymmetric simple truss is loaded as shown. Determine the reactions at A and D. Neglect the weight of the structure compared with the applied loads. [20 Points]



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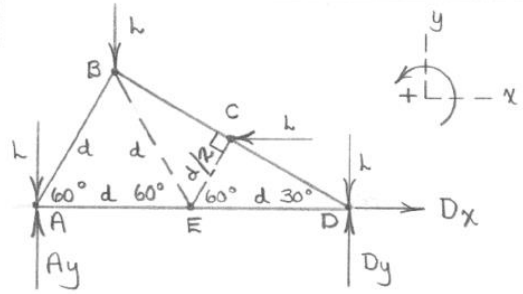

$\Sigma F_x = 0$: $D_x - L = 0$, $D_x = L$

$\Sigma F_y = 0$: $A_y + D_y - 3L = 0$

$\Sigma M_A = 0$: $D_y(2d) + L\left(\frac{d}{2}\frac{\sqrt{3}}{2}\right) - L\left(\frac{d}{2}\right) - L(2d) = 0$

Solving the last 2 equations : $A_y = \frac{L}{4}\left(7+\frac{\sqrt{3}}{2}\right)$

$D_y = \frac{L}{4}\left(5-\frac{\sqrt{3}}{2}\right)$

(or $A_y = 1.967L$, $D_y = 1.033L$)