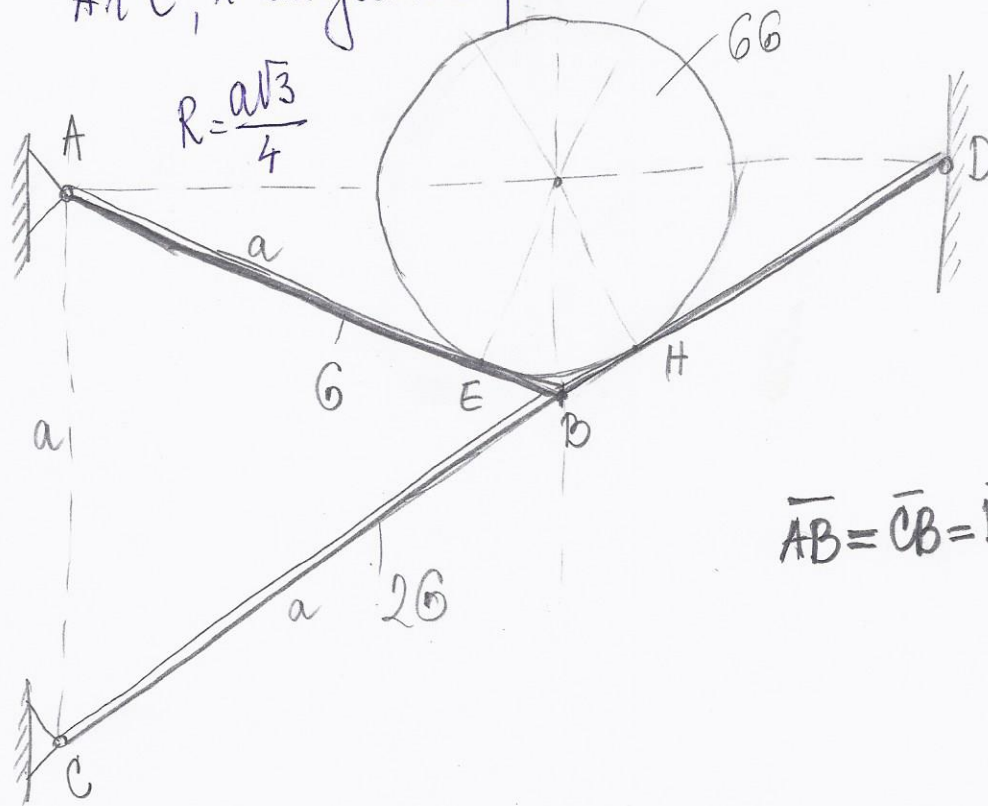


ZADACI III :

(1)

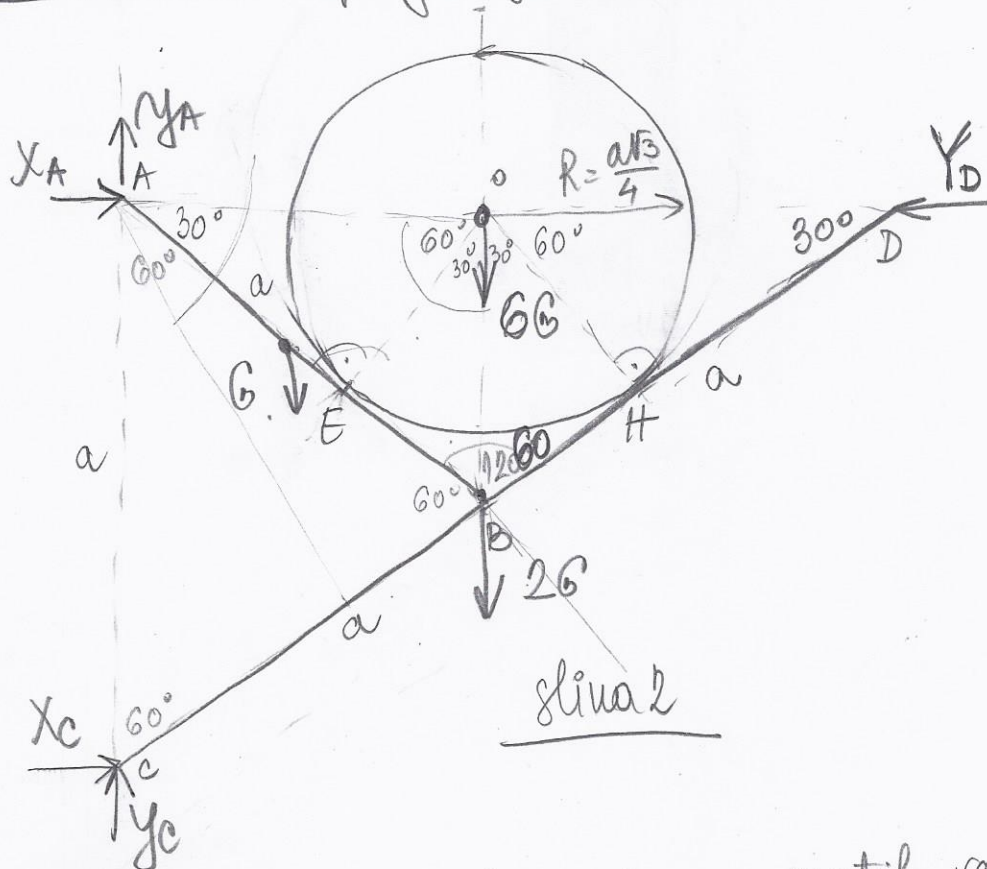
Zadatak 1: Homogeni štap AB, težine G , slobodno se oslanja u tački B, na homogeni štap CD, težine $2G$. Štap CD se slobodno oslanja na vertikalni glatki zid ($BC = BD$). Dva štapa nose homogeni disk O , poluprečnika R težine $6G$, koji se u tački A i H oslanja na štape. U prikazanom ravnotežnom položaju sistema $AB = BC = AC = a$, a tačke A i C su na istoj vertikali. Naći reakcije u zglobovima A i C, i uzajamne pritiske diska i štapa.



$$\overline{AB} = \overline{CB} = \overline{BD} = \overline{AC} = a$$

Rešenje:

Oslabađanje se spoljašnjih veza:



I Određivanje svih uglova i nepoznatih rastojanja
(uneti uglovi na crtežu)
(unete sve dužine mere)

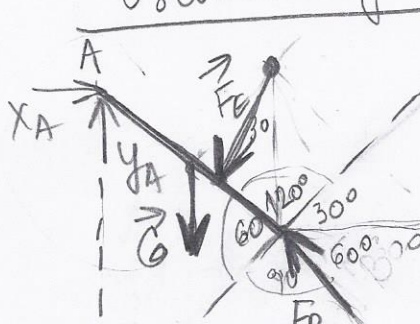
$$\bar{AO} = a \cos 30^\circ = a \frac{\sqrt{3}}{2}$$

$$\bar{BO} = a \cdot \cos 60^\circ = a \cdot \frac{1}{2}$$

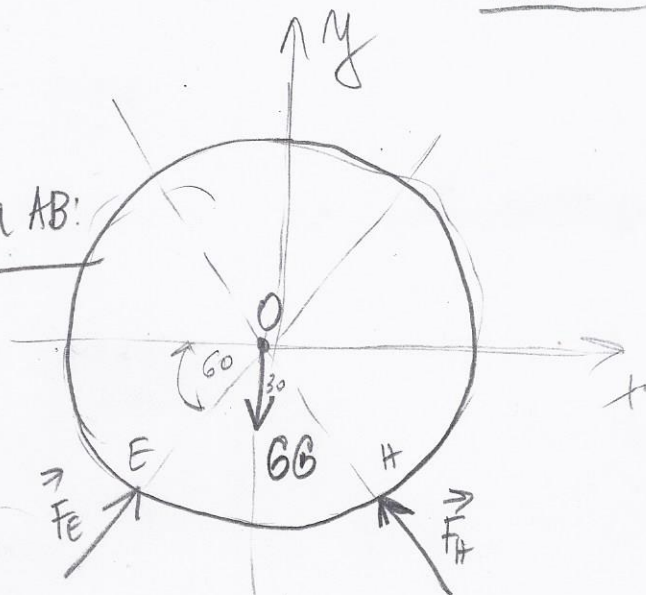
$$\bar{AE} = \bar{AO} \cos 30^\circ = a \frac{\sqrt{3}}{2} \cdot \frac{\sqrt{3}}{2} = \frac{3a}{4}$$

Oslabađanje od veza
slucaj:

Oslabađanje od veza štapa AB:



slucaj 3



Rastavljamo sistem na delove:

- disk - 2 uslova ravnoteže
- štap AB - 3 uslova ravnoteže
- štap CD - 3 uslova ravnoteže
- sistem - 3 uslova ravnoteže

Unutrašnje sile posle rastavljanja uoči se pojavljuju:

- disk na štapove u tačkama E i H
- pritisak između štapova

* Ukupno ima 11 uslova ravnoteže

* Nepoznatih reakcija - 8

* odavde biramo 8 jednačina

Sa slike 3:

$$(1) \sum X_i = 0 \Rightarrow -F_H \cos 60^\circ + F_E \cos 60^\circ = 0 \Rightarrow \boxed{F_E = F_H}$$

$$(2) \sum Y_i = 0 \Rightarrow F_E \cos 30^\circ - 66 + F_H \cos 30^\circ = 0$$

na osnovu (1):

$$2 F_E \cos 30^\circ = 66$$

$$F_E = \frac{66}{2 \cos 30^\circ} = \frac{66 \cdot 2 \cdot \frac{\sqrt{3}}{2}}{2 \cdot \frac{\sqrt{3}}{2}} = \frac{66 \sqrt{3}}{3} = \boxed{22\sqrt{3}}$$

$$\boxed{F_H = 22\sqrt{3}}$$

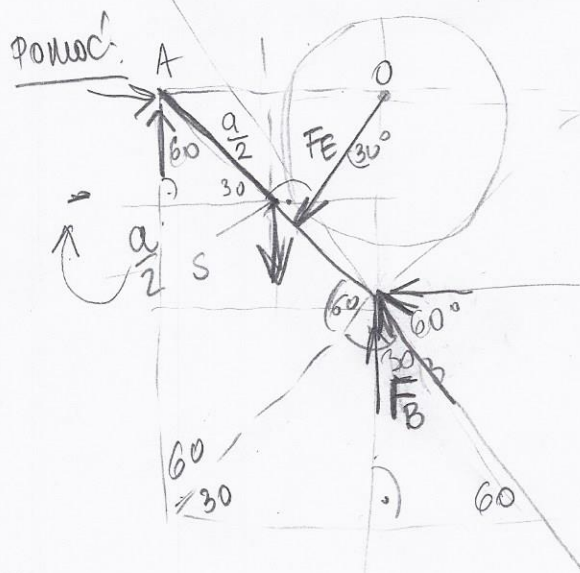
3a sline 3:

4

$$(3) \sum X_i = 0 \Rightarrow X_A - F_E \cos 60^\circ - F_B \cos 60^\circ = 0$$

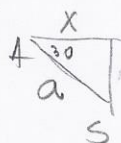
$$(4) \sum Y_i = 0 \Rightarrow Y_A - G - F_E \cos 30^\circ + F_B \cos 30^\circ = 0$$

$$(5) \sum M_A = 0 \Rightarrow -G \cdot x - F_E \cdot AO - F_{Bx} \cdot \frac{a}{2} + F_{By} \cdot AO = 0$$



$$AO = a \frac{\sqrt{3}}{2}$$

$$AS = \frac{a}{2}$$



$$x = a \cos 30^\circ$$

$$AE = \frac{3a}{4}$$

$$F_{Bx} = F_B \cdot \cos 60^\circ$$

$$F_{By} = F_B \cdot \cos 30^\circ$$

$$-G \cdot \frac{a}{2} \cos 30^\circ - F_E \cdot \frac{3a}{4} - F_B \cdot \cos 60^\circ \cdot \frac{a}{2} + F_B \cos 30^\circ \cdot \frac{a\sqrt{3}}{2} = 0$$

$$-G \cdot \frac{a}{2} \cdot \frac{\sqrt{3}}{2} - F_E \cdot \frac{3a}{4} - F_B \cdot \frac{1}{2} \cdot \frac{a}{2} + F_B \cdot \frac{\sqrt{3}}{2} \cdot \frac{a\sqrt{3}}{2} = 0$$

$$-G \cdot \frac{a}{2} \cdot \frac{\sqrt{3}}{2} - F_E \cdot \frac{3a}{4} - F_B \cdot \frac{a}{4} + F_B \cdot \frac{a \cdot 3}{4} = 0$$

$$-G \cdot \frac{a}{2} \cdot \frac{\sqrt{3}}{2} - F_E \cdot \frac{3a}{4} + 2aF_B \cdot \frac{1}{4} = 0$$

$$-G \cdot \frac{a}{2} \cdot \frac{\sqrt{3}}{2} - F_E \cdot \frac{3a}{4} + \frac{1}{2} \cdot F_B a = 0$$

$$a \cdot \frac{1}{2} F_B = G \cdot \frac{a}{2} \cdot \frac{\sqrt{3}}{2} + F_E \cdot \frac{3a}{4}$$

(5)

$$a \cdot F_B = 2 \cdot \left[\frac{6a\sqrt{3}}{4} + \frac{6a\sqrt{3}}{4} \right]$$

$$a \cdot F_B = \frac{76a\sqrt{3}}{4} \cdot 2$$

$$a \cdot F_B = \frac{76a\sqrt{3}}{2}$$

$$\boxed{F_B = \frac{76\sqrt{3}}{2}}$$

$$(3) \rightarrow X_A = F_E \cos 60^\circ + F_B \cdot \cos 60^\circ$$

$$X_A = \frac{46\sqrt{3}}{2} \cdot \frac{1}{2} + \frac{76\sqrt{3}}{2} \cdot \frac{1}{2}$$

$$\boxed{X_A = \frac{116\sqrt{3}}{4}}$$

$$(4) \quad Y_A = G + F_E \cos 30^\circ - F_B \cos 30^\circ$$

$$Y_A = G + 26\sqrt{3} \cdot \frac{\sqrt{3}}{2} - \frac{76\sqrt{3}}{2} \cdot \frac{\sqrt{3}}{2}$$

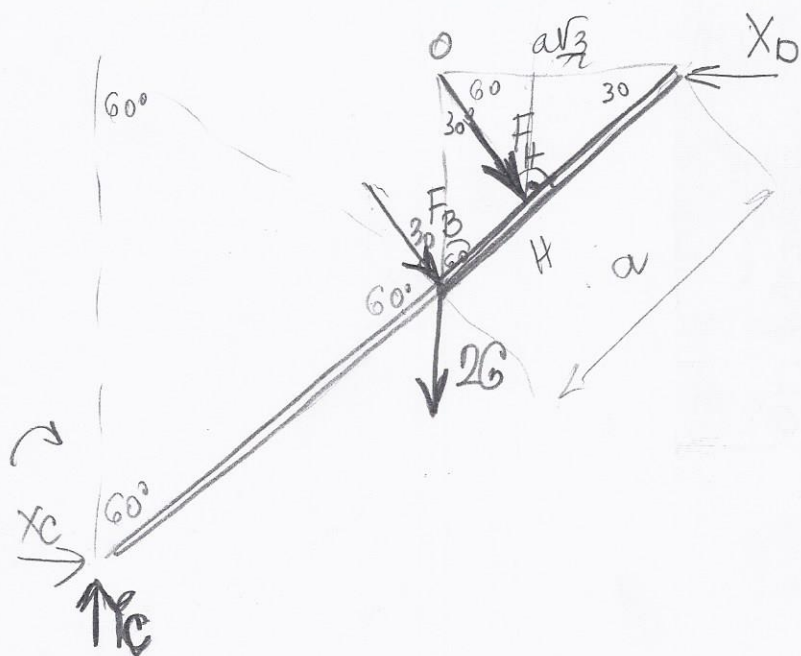
$$Y_A = G + 26 \cdot \frac{3}{2} - \frac{76 \cdot 3}{4}$$

$$Y_A = \frac{46}{4} + \frac{46 \cdot 3}{4} - \frac{7 \cdot 6 \cdot 3}{4}$$

$$Y_A = \frac{46 + 126 - 216}{4} = \boxed{-\frac{56}{4}} \quad * \text{menjadi smel}$$

ravnoteža štapa CD:

6



$$OD = OA = \frac{a\sqrt{3}}{2}$$

$$\overline{DH} = \frac{a\sqrt{3}}{2} \cdot \cos 30^\circ = \frac{a\sqrt{3}}{2} \cdot \frac{\sqrt{3}}{2}$$

$$\overline{DH} = \frac{3a}{4}$$

$$(6) \sum X_i = 0 \Rightarrow -X_D + F_H \cos 60^\circ + X_C + F_B \cos 60^\circ = 0$$

$$(7) \sum Y_i = 0 \Rightarrow Y_C - 2G - F_B \cos 30^\circ - F_H \cos 30^\circ = 0$$

$$(8) \sum M_i^C = 0 \Rightarrow -2G \cdot \frac{a\sqrt{3}}{2} - F_B \cdot a - F_H \cdot (2a - \frac{3a}{4}) + X_D \cdot a = 0$$

$$17 (7) \Rightarrow Y_C = 2G + F_B \cos 30^\circ + F_H \cos 30^\circ$$

$$Y_C = 2G + \frac{7G\sqrt{3}}{2} \cdot \frac{\sqrt{3}}{2} + 2G\sqrt{3} \cdot \frac{\sqrt{3}}{2}$$

$$Y_C = 2G + \frac{21G}{4} + \frac{6G}{2}$$

$$Y_C = \frac{8G + 21G + 12G}{4} = \frac{41G}{4}$$

$$X_D \cdot a = 2G \frac{a\sqrt{3}}{2} + \frac{7G\sqrt{3}}{2} \cdot a + 2G\sqrt{3} \cdot (2a - \frac{3a}{4})$$

$$X_D = \frac{2G\sqrt{3}}{2} + \frac{7G\sqrt{3}}{2} + 4G\sqrt{3} - \frac{6G\sqrt{3}}{4}$$

$$X_D = G\sqrt{3} + 7G\sqrt{3} + 8G\sqrt{3} - 3G\sqrt{3} = 14G\sqrt{3}$$

(7)

$$12(6): X_c = X_D - F_H \cos 60 - F_B \cos 60$$

$$X_c = 76\sqrt{3} - 26\sqrt{3} \cdot \frac{1}{2} - \frac{76\sqrt{3}}{2} \cdot \frac{1}{2}$$

$$X_c = \frac{286\sqrt{3}}{4} - \frac{46\sqrt{3}}{4} - \frac{76\sqrt{3}}{4}$$

$$X_c = \frac{6\sqrt{3}(28-4-7)}{4}$$

$$X_c = \frac{6\sqrt{3} \cdot 17}{4}$$

$$X_c = \frac{176\sqrt{3}}{4}$$