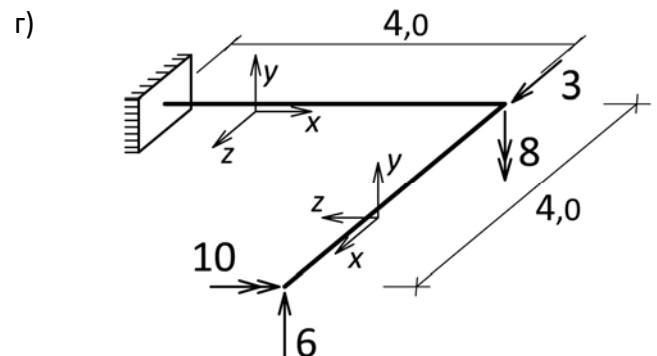
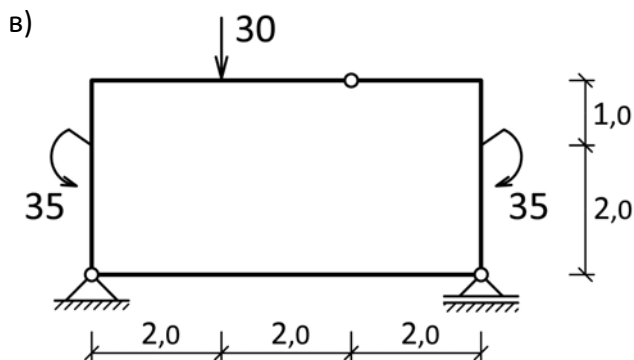
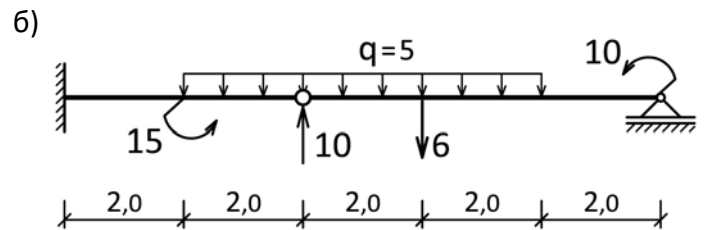
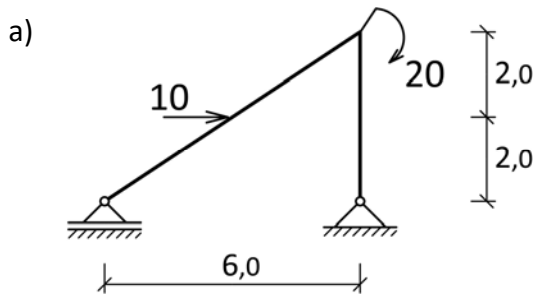


ГРАЂЕВИНСКИ ФАКУЛТЕТ УНИВЕРЗИТЕТА У БЕОГРАДУ
 Усмени (теоријски) део испита из **ТЕХНИЧКЕ МЕХАНИКЕ 1**
 (писмени део одржан 06.06.2019.)

1. ЗАДАТАК (условни 50 %)

Нацртати дијаграме сила у пресеку за приказане носаче.

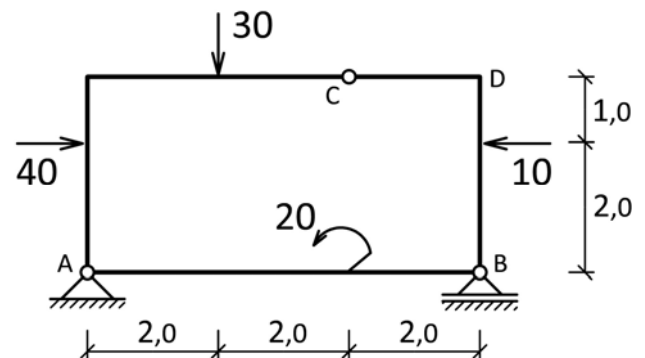


2. ЗАДАТАК (28 %)

a) Навести D'Alambert-ов принцип виртуелних радова.

б) Применом опште једначине статике одредити (за приказани носач):

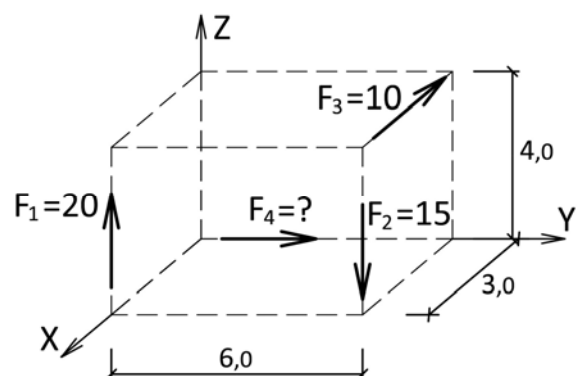
- * хоризонталну реакцију везе у ослоњу А,
- * вертикалну реакцију везе у ослоњу А,
- * моменат савијања у крутом углу D.



3. ЗАДАТАК (22 %)

a) Објаснити појмове прве и друге статичке инваријанте за систем сила у простору.

б) Приказани систем сила се састоји од три познате и једне непознате силе. Одредити непознату силу тако да систем има резултанту, а затим наћи вектор резултанте и једначину њене нападне линије.



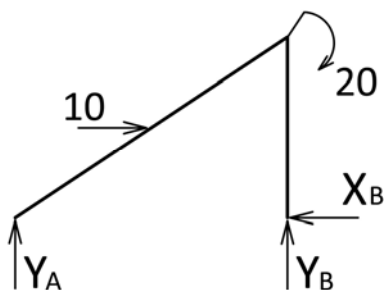
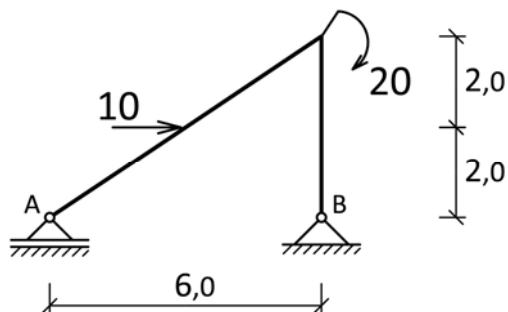
Напомена: У свим задацима димензије за дужине и силе су: m, N

ГРАЂЕВИНСКИ ФАКУЛТЕТ УНИВЕРЗИТЕТА У БЕОГРАДУ
 Усмени (теоријски) део испита из **ТЕХНИЧКЕ МЕХАНИКЕ 1**
 (писмени део одржан 06.06.2019.)

- Р Е Ш Е Њ А -

1. ЗАДАТАК (условни 50 %)

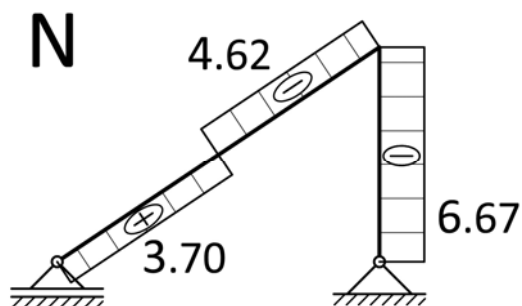
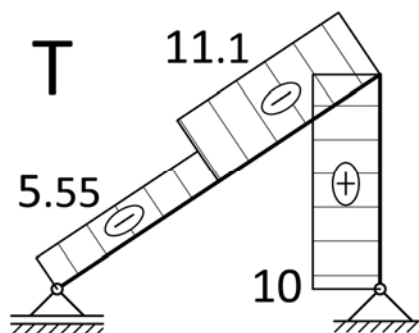
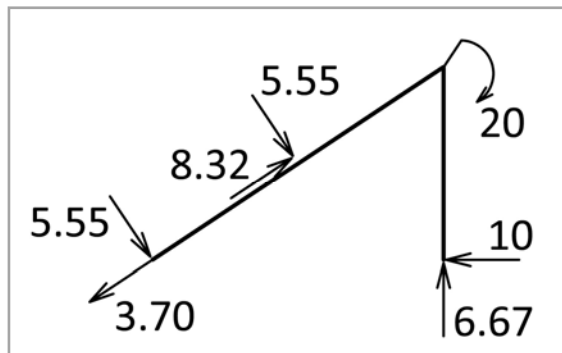
a)

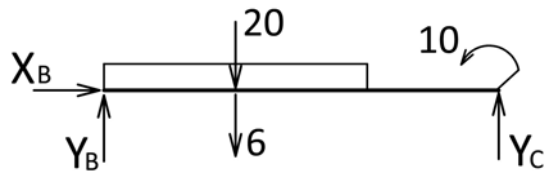
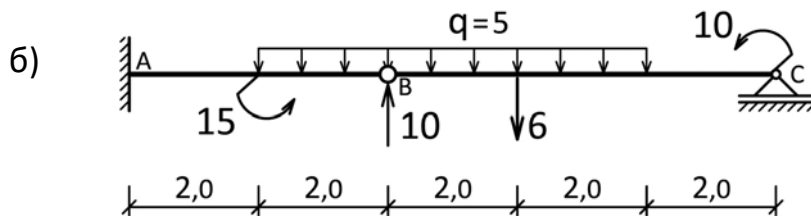


$$\sum F_X = 0 : -X_B + 10 = 0 \rightarrow \underline{X_B = 10}$$

$$\sum M_A = 0 : Y_B \cdot 6 - 10 \cdot 2 - 20 = 0 \rightarrow \underline{Y_B = 6.67}$$

$$\sum F_Y = 0 : Y_A + Y_B = 0 \rightarrow \underline{Y_A = -6.67}$$

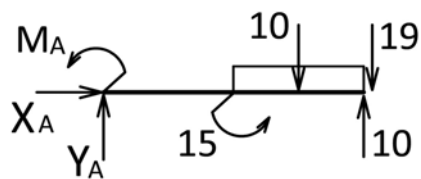




$$\sum F_x = 0 : \underline{X_B = 0}$$

$$\sum M_B = 0 : Y_C \cdot 6 - 20 \cdot 2 - 6 \cdot 2 + 10 = 0 \rightarrow \underline{Y_C = 7}$$

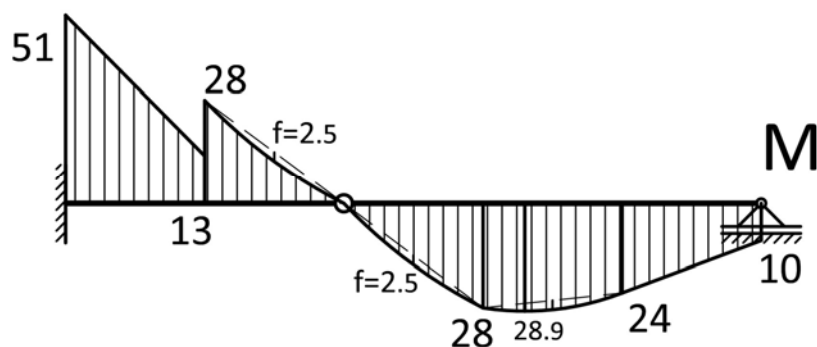
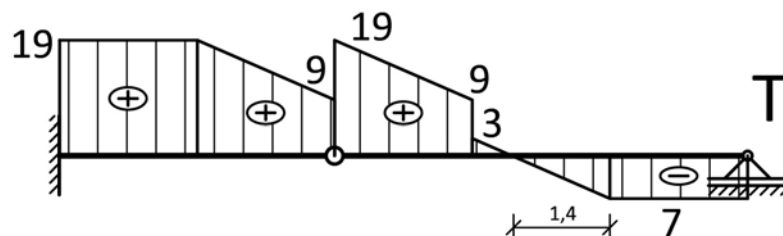
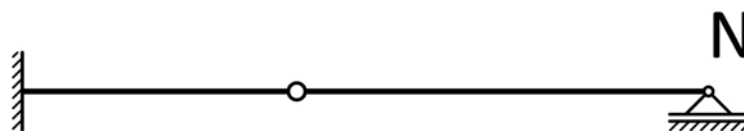
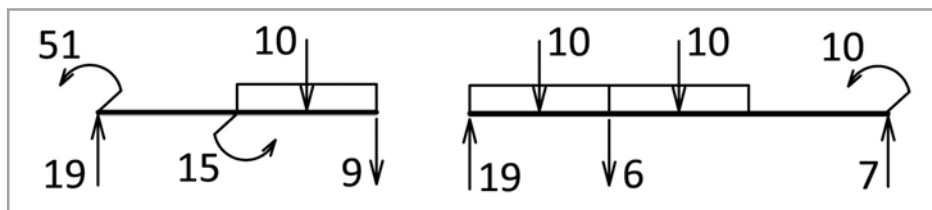
$$\sum F_y = 0 : Y_B + Y_C - 20 - 6 = 0 \rightarrow \underline{Y_B = 19}$$



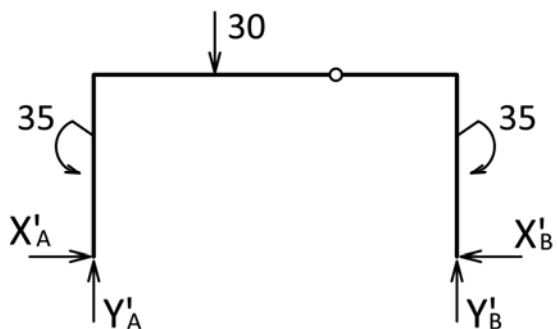
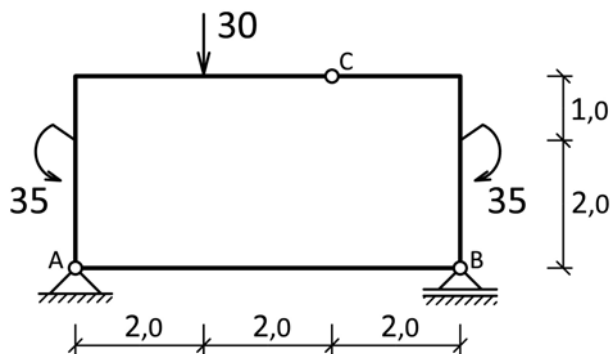
$$\sum F_x = 0 : \underline{X_A = 0}$$

$$\sum F_y = 0 : Y_A - 10 - 19 + 10 = 0 \rightarrow \underline{Y_A = 19}$$

$$\sum M_A = 0 : M_A - 10 \cdot 3 - 19 \cdot 4 + 10 \cdot 4 + 15 = 0 \rightarrow \underline{M_A = 51}$$



B)

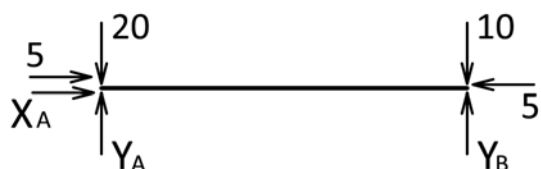


$$\sum M_A = 0 : Y'_B \cdot 6 - 30 \cdot 2 - 35 + 35 = 0 \rightarrow \underline{Y'_B = 10}$$

$$\sum F_Y = 0 : Y'_A + Y'_B - 30 = 0 \rightarrow \underline{Y'_A = 20}$$

$$\sum M_{C, \text{dec}} = 0 : X'_B \cdot 3 - Y'_B \cdot 2 + 35 = 0 \rightarrow \underline{X'_B = -5}$$

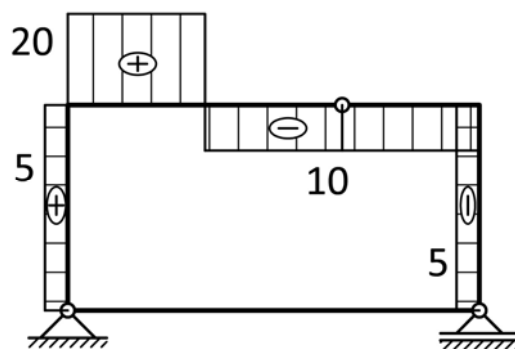
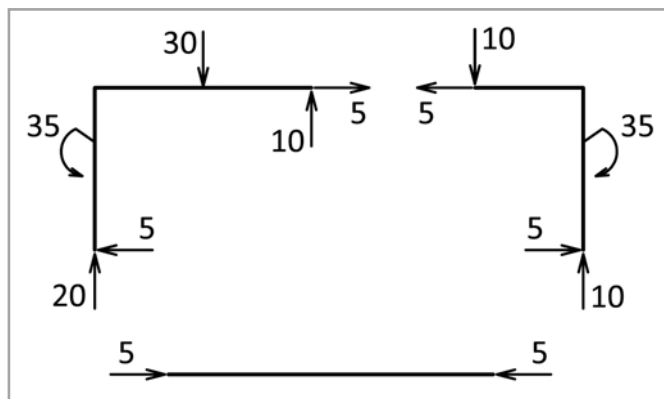
$$\sum F_X = 0 : X'_A - X'_B = 0 \rightarrow \underline{X'_A = -5}$$



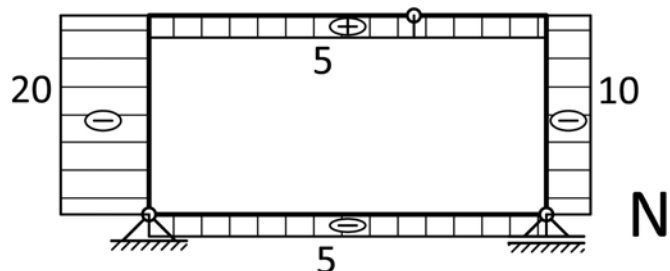
$$\sum F_X = 0 : X_A + 5 - 5 = 0 \rightarrow \underline{X_A = 0}$$

$$\sum M_A = 0 : Y_B \cdot 6 - 10 \cdot 6 = 0 \rightarrow \underline{Y_B = 10}$$

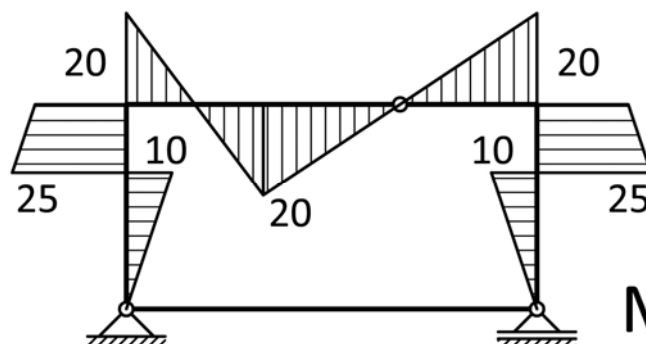
$$\sum F_Y = 0 : Y_A + Y_B - 20 - 10 = 0 \rightarrow \underline{Y_A = 20}$$



T

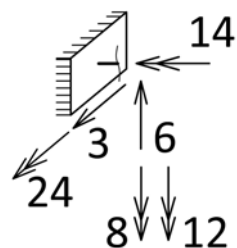
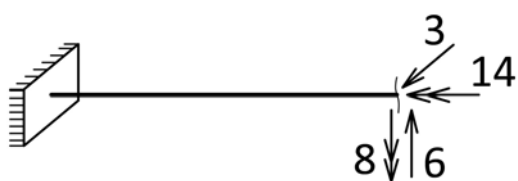
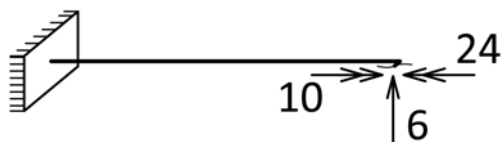
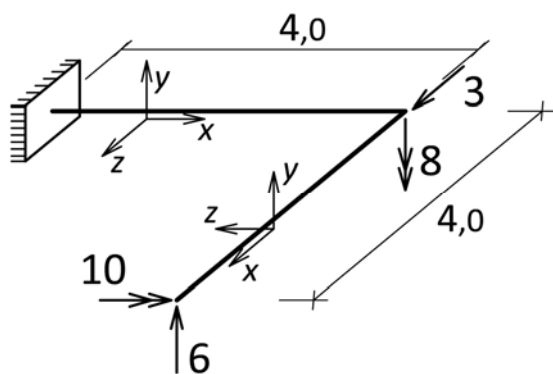


N

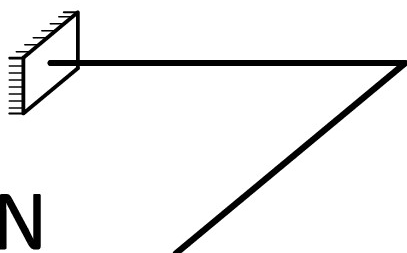


M

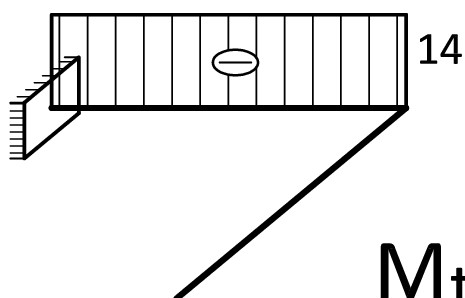
r)



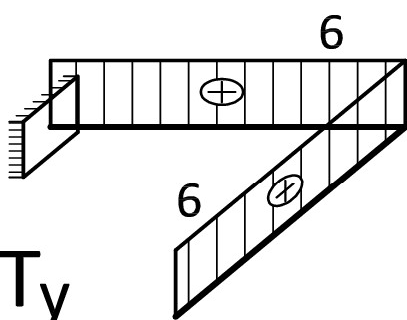
N



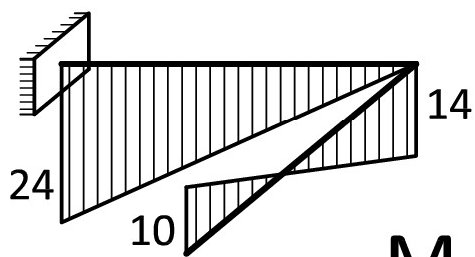
M_t



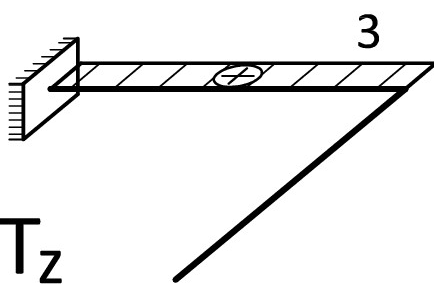
T_y



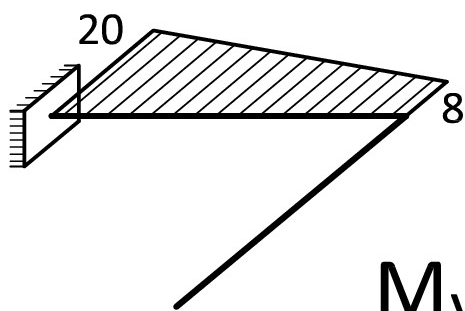
M_z



T_z

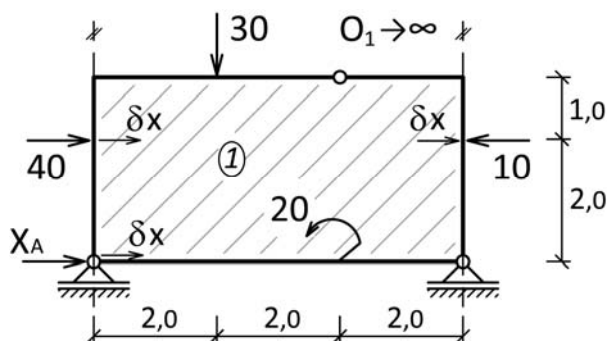


M_y



2. ЗАДАТАК (28 %)

б) $X_A = ?$

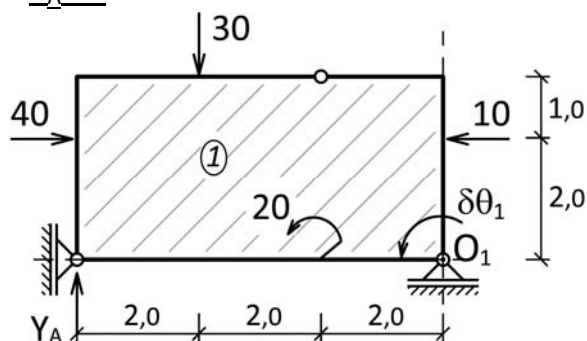


$$O_1 \rightarrow \infty \rightarrow \delta\theta_1 = 0$$

$$\delta A = X_A \cdot \delta x + 40 \cdot \delta x - 10 \cdot \delta x = 0$$

$$\rightarrow \underline{X_A = -30}$$

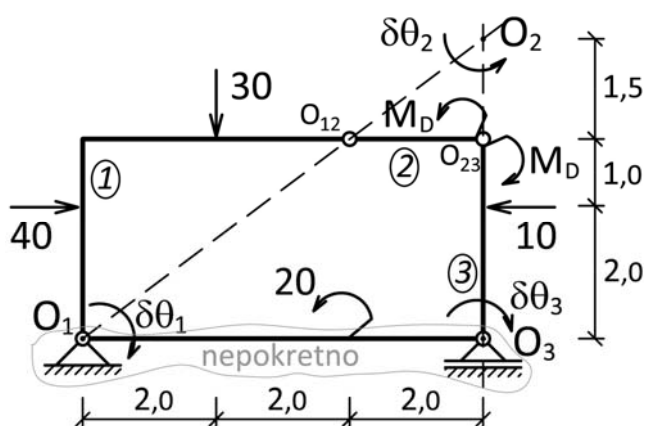
$Y_A = ?$



$$\delta A = -Y_A \cdot (6 \cdot \delta\theta_1) + 10 \cdot (2 \cdot \delta\theta_1) + 30 \cdot (4 \cdot \delta\theta_1)$$

$$- 40 \cdot (2 \cdot \delta\theta_1) + 20 \cdot \delta\theta_1 = 0 \rightarrow \underline{Y_A = 13.33}$$

$M_D = ?$



$$\delta r_{O_{12},y} = \delta\theta_1 \cdot 4 = \delta\theta_2 \cdot 2 \rightarrow \delta\theta_1 = 0.5 \cdot \delta\theta_2$$

$$\delta r_{O_{23}} = \delta\theta_2 \cdot 1.5 = \delta\theta_3 \cdot 3 \rightarrow \delta\theta_3 = 0.5 \cdot \delta\theta_2$$

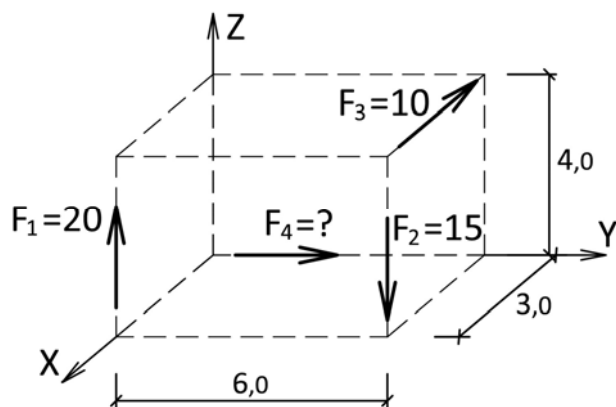
$$\delta A = 40 \cdot (2 \cdot \delta\theta_1) + 30 \cdot (2 \cdot \delta\theta_1) + M_D \cdot \delta\theta_2 - 10 \cdot (2 \cdot \delta\theta_3) + M_D \cdot \delta\theta_3 = 0$$

$$1.5 \cdot M_D \cdot \delta\theta_2 + 60 \cdot \delta\theta_2 = 0$$

$$\rightarrow \underline{M_D = -40}$$

3. ЗАДАТАК (22 %)

6)



$$\vec{F}_R = \{-10, F_4, 5\}$$

$$\vec{M}_R^{(0)} = \{-90, -55, 60\}$$

Услов за постојање РЕЗУЛТАНТЕ: $\vec{F}_R \cdot \vec{M}_R = 0$

$$(-10) \cdot (-90) + F_4 \cdot (-55) + 5 \cdot 60 = 0 \quad \rightarrow \quad F_4 = 21.82$$

$$\Rightarrow \vec{F}_R = \{-10, 21.82, 5\}$$

$$|\vec{F}_R| = 24.516$$

Једначина нападне линије резултанте:

$$\frac{x + \frac{M_{RY}}{Z_R}}{X_R} = \frac{y - \frac{M_{RX}}{Z_R}}{Y_R} = \frac{z}{Z_R} \quad \Rightarrow \quad \frac{x + \frac{(-55)}{5}}{-10} = \frac{y - \frac{(-90)}{5}}{21.82} = \frac{z}{5}$$

$$\Rightarrow \begin{cases} x + 2z - 11 = 0 \\ y - 4.36z + 18 = 0 \end{cases}$$