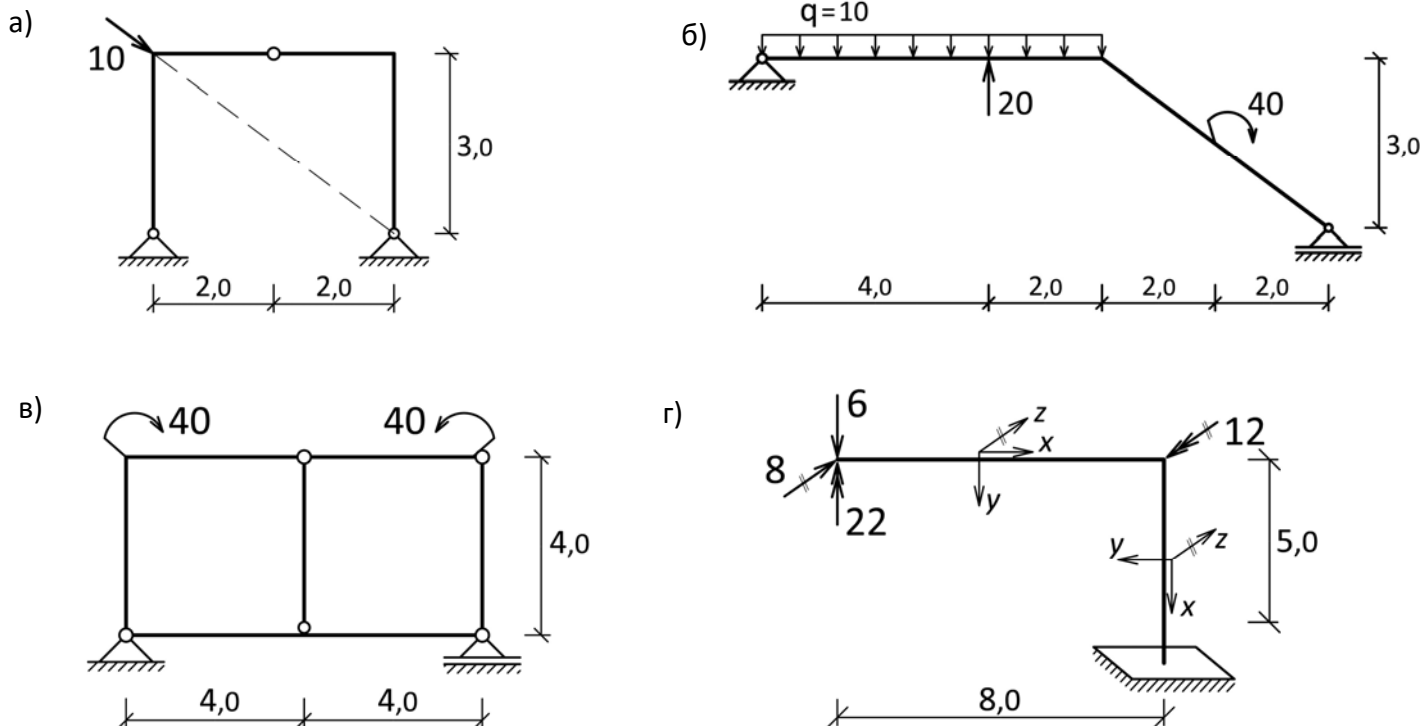


ГРАЂЕВИНСКИ ФАКУЛТЕТ УНИВЕРЗИТЕТА У БЕОГРАДУ
 Усмени (теоријски) део испита из **ТЕХНИЧКЕ МЕХАНИКЕ 1**
 (писмени део одржан 23.08.2019.)

1. ЗАДАТАК (условни 50 %)

Нацртати дијаграме сила у пресеку за приказане носаче.



2. ЗАДАТАК (30 %)

а) Приказати поступак трансформације спрега у простору.

б) За дати систем сила одредити силу \vec{F}_3 и координату z њене нападне тачке тако да се систем сила своди на резултанту $\vec{F}_R = \{240, -140, -240\}$, а затим одредити једначину њене нападне линије.

$$\vec{F}_1 = \{140, -80, -200\} \quad P_1 = (-2, 3, 4)$$

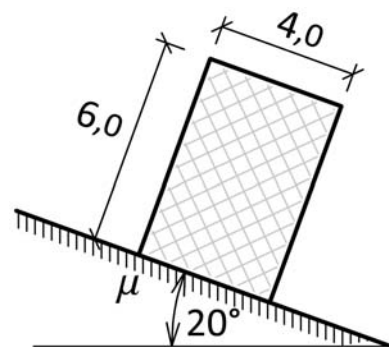
$$\vec{F}_2 = \{240, -60, -100\} \quad P_2 = (3, 4, -5)$$

$$\vec{F}_3 = \{X_3, Y_3, Z_3\} \quad P_3 = (2, 2, z)$$

3. ЗАДАТАК (20 %)

а) Објаснити појам силе трења

б) Приказано тело тежине 100 N налази се на храпавој стрмој равни која је за 20° нагнута у односу на хоризонталу. Израчунати коефицијент сигурности против претурања. Одредити коефицијент трења ($\mu=?$) при коме су коефицијент сигурности против клизања и против претурања једнаки.

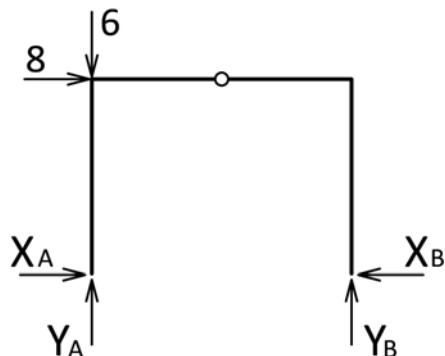
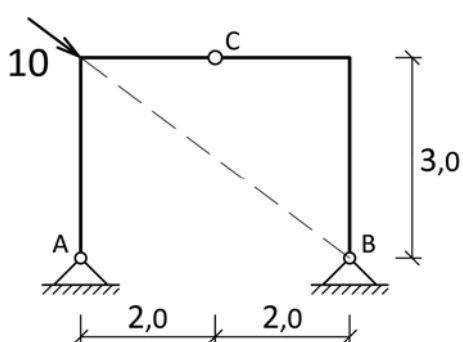


Напомена: У свим задацима димензије за дужине и силе су: m, N .

- Р Е Ш Е Њ А -

1. ЗАДАТАК (условни 50 %)

a)

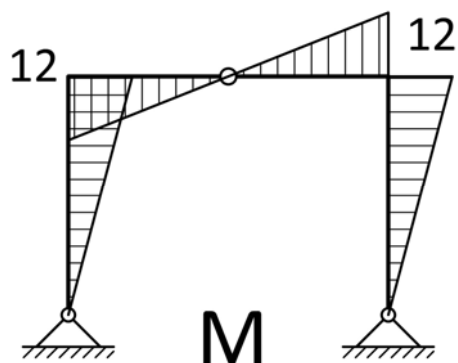
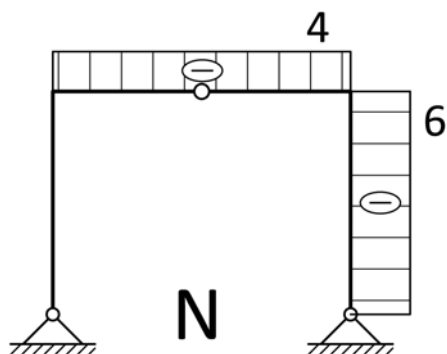
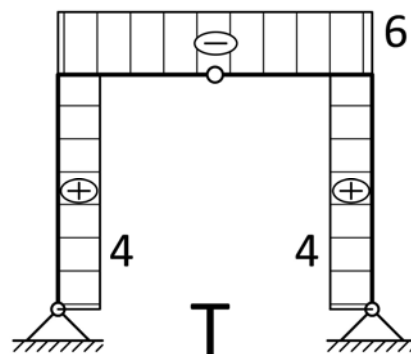
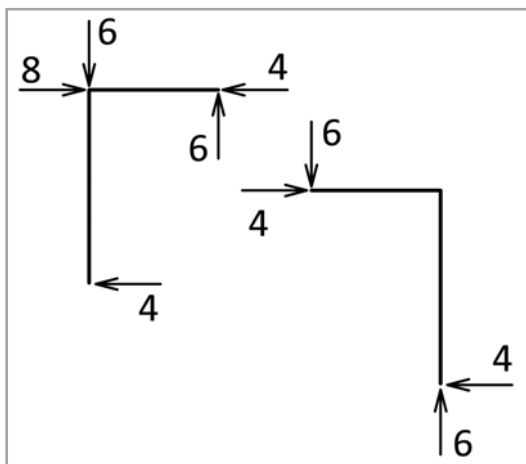


$$\sum M_A = 0 : Y_B \cdot 4 - 8 \cdot 3 = 0 \rightarrow \underline{Y_B = 6}$$

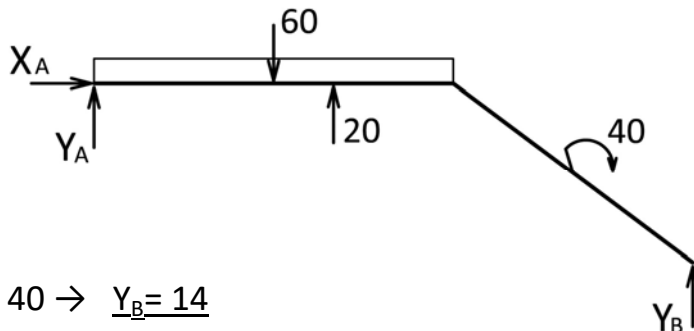
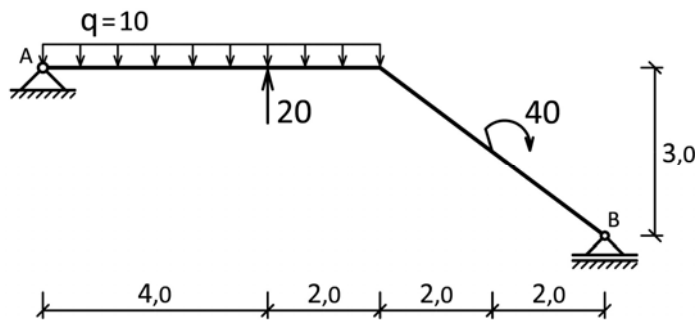
$$\sum F_Y = 0 : Y_A + Y_B - 6 = 0 \rightarrow \underline{Y_A = 0}$$

$$\sum M_{C, \text{дес}} = 0 : X_B \cdot 3 - Y_B \cdot 2 = 0 \rightarrow \underline{X_B = 4}$$

$$\sum F_X = 0 : X_A - X_B + 8 = 0 \rightarrow \underline{X_A = -4}$$



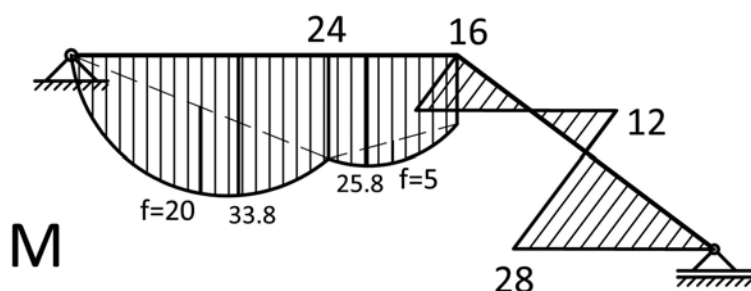
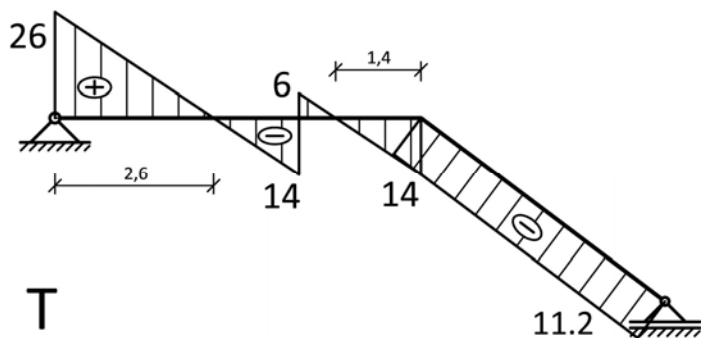
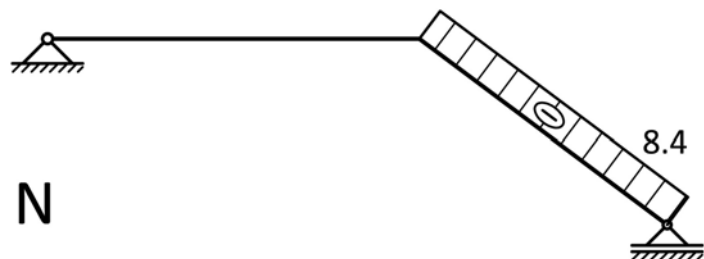
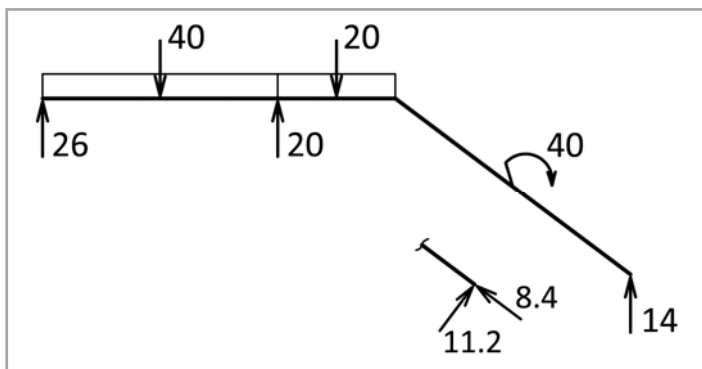
6)



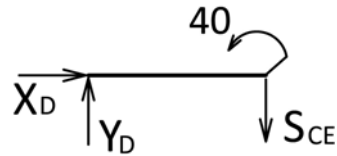
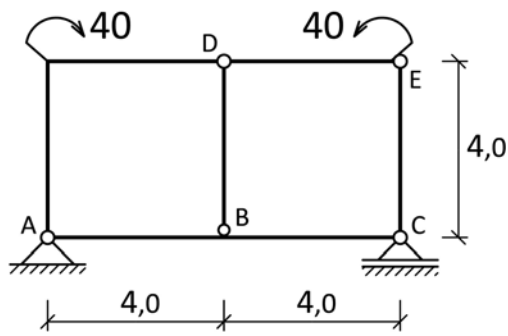
$$\sum F_x = 0 : X_A = 0$$

$$\sum M_A = 0 : Y_B \cdot 10 - 60 \cdot 3 + 20 \cdot 4 - 40 \rightarrow Y_B = 14$$

$$\sum F_y = 0 : Y_A + Y_B - 60 + 20 = 0 \rightarrow Y_A = 26$$



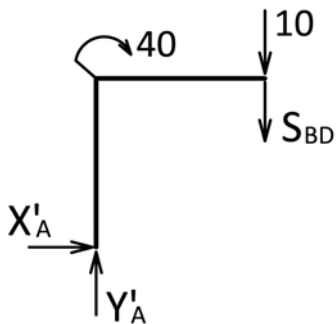
B)



$$\sum F_x = 0 : \rightarrow \underline{X_D = 0}$$

$$\sum M_D = 0 : S_{CE} \cdot 4 - 40 = 0 \rightarrow \underline{S_{CE} = 10}$$

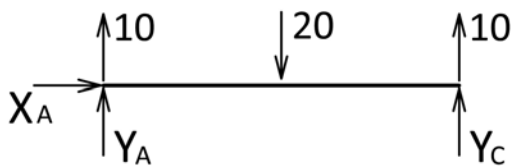
$$\sum F_y = 0 : Y_D - S_{CE} = 0 \rightarrow \underline{Y_D = 10}$$



$$\sum F_x = 0 : \rightarrow \underline{X'_A = 0}$$

$$\sum M_A = 0 : S_{BD} \cdot 4 + 10 \cdot 4 + 40 = 0 \rightarrow \underline{S_{BD} = -20}$$

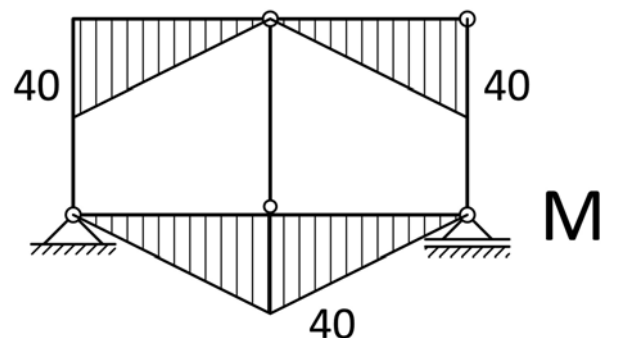
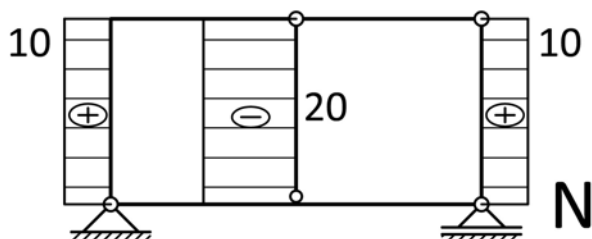
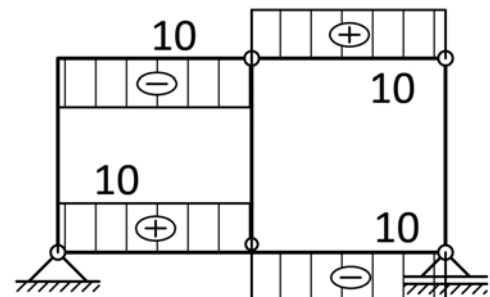
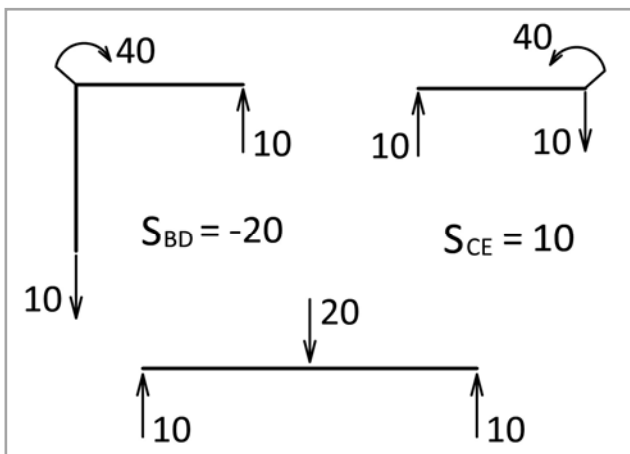
$$\sum F_y = 0 : Y'_A - S_{BD} - 10 = 0 \rightarrow \underline{Y'_A = -10}$$



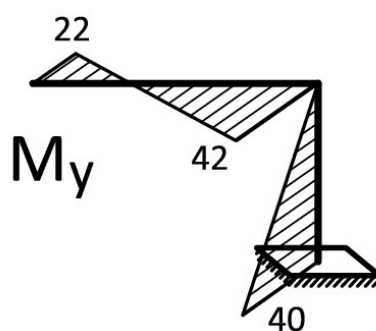
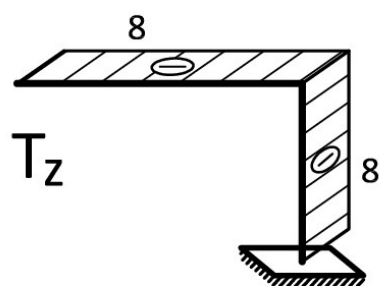
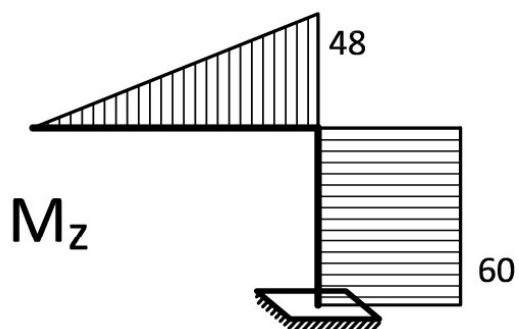
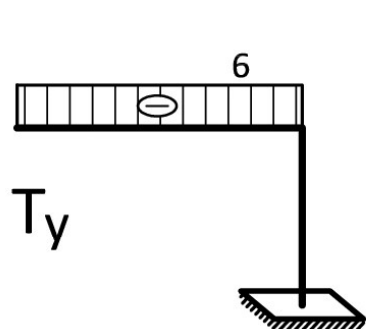
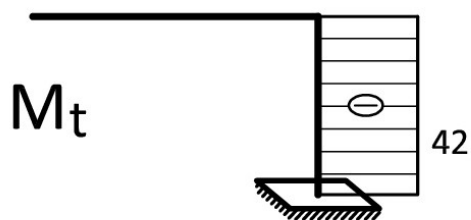
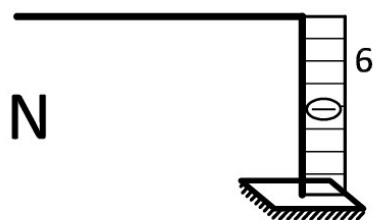
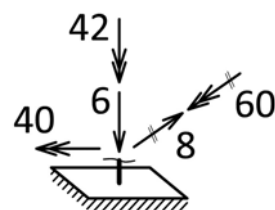
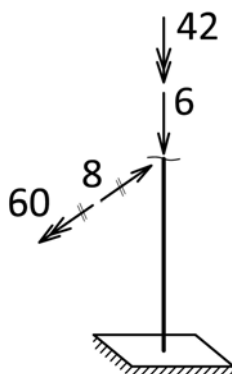
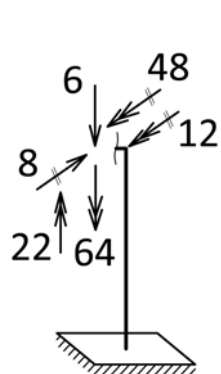
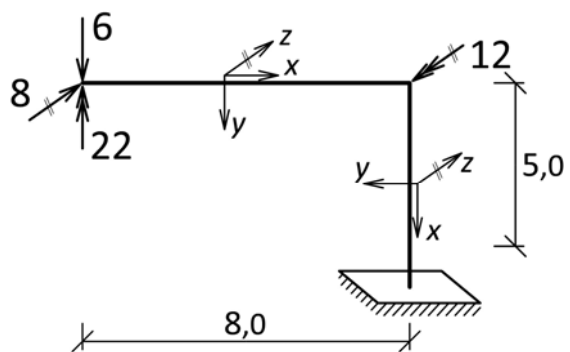
$$\sum F_x = 0 : \rightarrow \underline{X_A = 0}$$

$$\sum M_A = 0 : Y_C \cdot 8 + 10 \cdot 8 - 20 \cdot 4 = 0 \rightarrow \underline{Y_C = 0}$$

$$\sum F_y = 0 : Y_A + Y_C - 20 + 10 + 10 = 0 \rightarrow \underline{Y_A = 0}$$



r)



2. ЗАДАТАК (30 %)

$$б) \quad \vec{F}_1 = \{140, -80, -200\} \quad P_1 = (-2, 3, 4)$$

$$\vec{F}_2 = \{240, -60, -100\} \quad P_2 = (3, 4, -5)$$

$$\vec{F}_3 = \{X_3, Y_3, Z_3\} \quad P_3 = (2, 2, z)$$

$$\vec{F}_R = \{380 + X_3, -140 + Y_3, -300 + Z_3\}$$

$$\vec{F}_R = \{240, -140, -240\} \Rightarrow \underline{X_3 = -140, \quad Y_3 = 0, \quad Z_3 = 60}$$

$$\vec{M}_1^{(0)} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ -2 & 3 & 4 \\ 140 & -80 & -200 \end{vmatrix} = \{-280, 160, -260\}$$

$$\vec{M}_2^{(0)} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 3 & 4 & -5 \\ 240 & -60 & -100 \end{vmatrix} = \{-700, -900, -1140\}$$

$$\vec{M}_3^{(0)} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 2 & 2 & z \\ -140 & 0 & 60 \end{vmatrix} = \{120, -120 - 140z, 280\}$$

$$\vec{M}_R^{(0)} = \{-860, -860 - 140z, -1120\}$$

Услов за егзистенцију резултанте: $\vec{F}_R \cdot \vec{M}_R^{(0)} = 0$

$$\vec{F}_R \cdot \vec{M}_R^{(0)} = 240 \cdot (-860) + (-140) \cdot (-860 - 140z) + (-240) \cdot (-1120) = 0$$

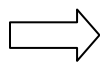
$$19600z + 182800 = 0 \Rightarrow \underline{z = -9.326}$$

$$\vec{M}_R^{(0)} = \{-860, -2165.7, -1120\}$$

Једначина нападне линије резултанте:

$$\frac{x + \frac{M_{Ry}^{(0)}}{Z_R}}{X_R} = \frac{y - \frac{M_{Rx}^{(0)}}{Z_R}}{Y_R} = \frac{z}{Z_R}$$

$$\frac{x + \frac{-2166}{-240}}{240} = \frac{y - \frac{-860}{-240}}{-140} = \frac{z}{-240}$$



$$\frac{x + 9.024}{240} = \frac{y - 3.58}{-140} = \frac{z}{-240}$$

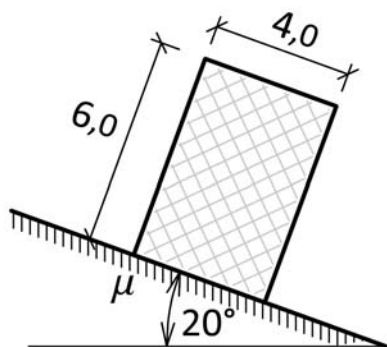
или

$$x - z = -9.02$$

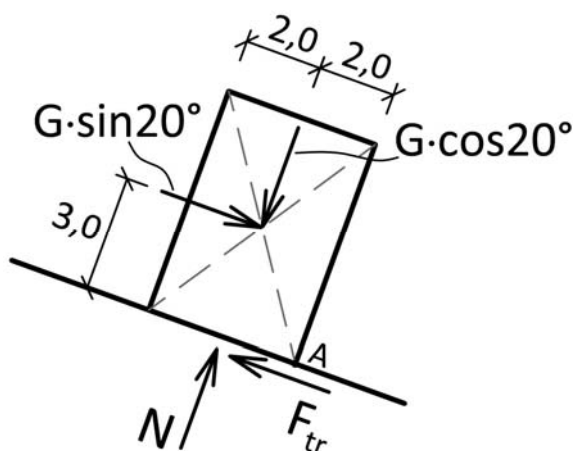
$$\underline{1.71y + z = 6.14}$$

3. ЗАДАТАК (20 %)

b)



$$G = 100 \text{ N}$$



$$G \cdot \sin 20^\circ = 34.20 \text{ N}$$

$$G \cdot \cos 20^\circ = 93.97 \text{ N}$$

$$N = G \cdot \cos 20^\circ = 93.97 \text{ N}$$

$$F_{tr} = \mu \cdot N$$

Коефицијент сигурности против претурања:

Моменат претурања: $M_A = G \cdot \sin 20^\circ \cdot 3.0 = 102.61$

Моменат отпора претурању: $M_A^* = G \cdot \cos 20^\circ \cdot 2.8 = 187.94$

$$\gamma_{PR} = \frac{M_A^*}{M_A} = \frac{187.94}{102.61} = \frac{4.865}{h} = 1.832$$

Коефицијент сигурности против клизања:

$$\gamma_{KL} = \frac{\mu \cdot N}{G \cdot \sin 20^\circ} = \frac{\mu \cdot 93.97}{34.20} = \gamma_{PR} = 1.832 \Rightarrow \mu \cdot 93.97 = 62.64$$
$$\mu = 0.66$$