# LÖSNINGAR

# TILL

# TENTAMEN I

# MEKANIK TMMI39 f.k.

# 081218

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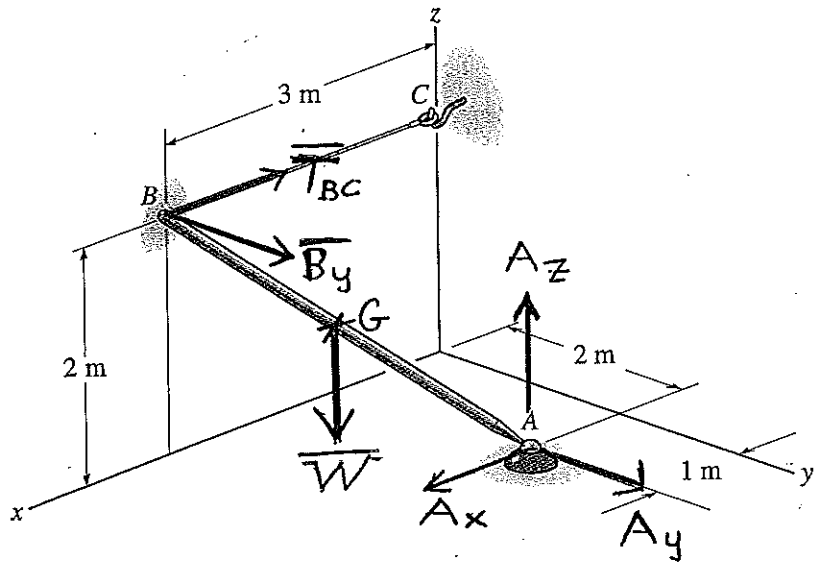


$$\Sigma \overline{M}_A = \overline{0}$$

$$\Sigma \overline{M}_A = \overline{r}_{AB} \times \overline{B}_y + \overline{r}_{AB} \times \overline{T}_{BC} + \overline{r}_{AG} \times \overline{W}$$

$$\overline{r}_{AB} = 2\overline{i} - 2\overline{j} + 2\overline{k} \qquad \overline{r}_{AG} = \overline{i} - \overline{j} + \overline{k}$$

$$\overline{B}_y = B_y \overline{j} \qquad \overline{T}_{BC} = -T_{BC}\overline{i} \qquad \overline{W} = -mg\overline{k} = -49{,}05\overline{k}$$

$$\Sigma \overline{M}_A = \begin{vmatrix} \overline{i} & \overline{j} & \overline{k} \\ 2 & -2 & 2 \\ 0 & B_y & 0 \end{vmatrix} + \begin{vmatrix} \overline{i} & \overline{j} & \overline{k} \\ 2 & -2 & 2 \\ -T_{BC} & 0 & 0 \end{vmatrix} + \begin{vmatrix} \overline{i} & \overline{j} & \overline{k} \\ 1 & -1 & 1 \\ 0 & 0 & -49{,}05 \end{vmatrix} = \overline{0}$$

$$(-2B_y\overline{i} + 2B_y\overline{k}) + (-2T_{BC}\overline{j} - 2T_{BC}\overline{k}) +$$

$$+ (49{,}05\overline{i} + 49{,}05\overline{j}) = \overline{0}$$

X-led ① $\quad -2B_y + 49{,}05 = 0 \quad \Rightarrow B_y = 24{,}5N$

y-led ② $\quad -2T_{BC} + 49{,}05 = 0 \quad \Rightarrow T_{BC} = 24{,}5N$

Z-led ③ $\quad 2B_y - 2T_{BC} = 0 \quad \Rightarrow B_y = T_{BC}$

Svar: $B_y = T_{BC} = 24{,}5\ N$

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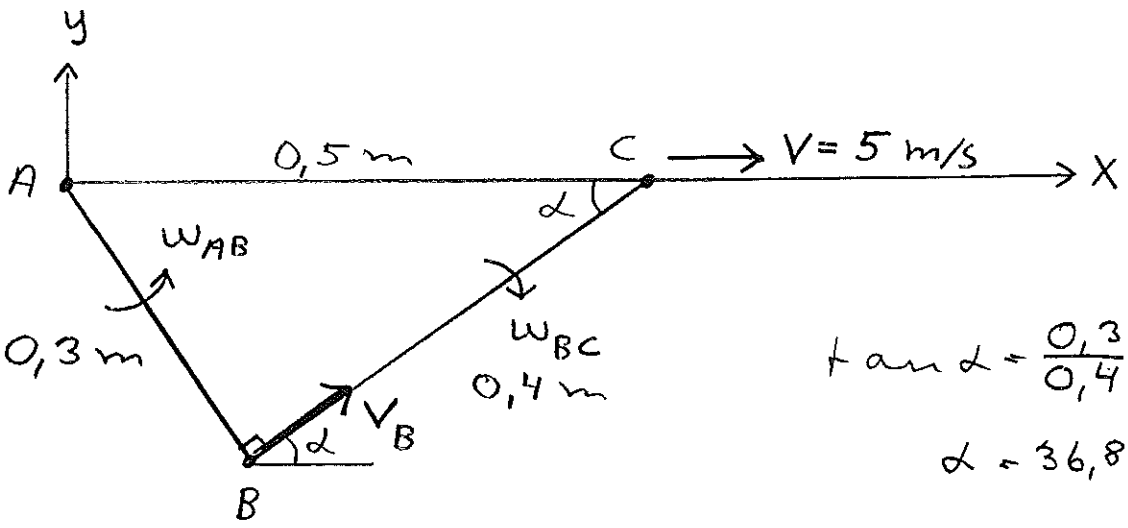
2)




$\tan\alpha = \frac{0,3}{0,4}$

$\alpha = 36,87^\circ$

$$\overline{V_C} = \overline{V_B} + \overline{\omega_{BC}} \times \overline{BC}$$

$$V_B = 0,3 \cdot \omega_{AB}$$

$$\overline{V_B} = 0,3\,\omega_{AB} \cos 36,87^\circ\, \bar{i} + 0,3\,\omega_{AB} \sin 36,87^\circ\, \bar{j}$$

$$\overline{V_B} = 0,3\,\omega_{AB} \cdot 0,8\,\bar{i} + 0,3\,\omega_{AB} \cdot 0,6\,\bar{j}$$

$$\overline{V_B} = 0,24\,\omega_{AB}\,\bar{i} + 0,18\,\omega_{AB}\,\bar{j}$$

$$\begin{Bmatrix} 5 \\ 0 \\ 0 \end{Bmatrix} = \begin{Bmatrix} 0,24\omega_{AB} \\ 0,18\,\omega_{AB} \\ 0 \end{Bmatrix} + \boxed{\begin{Bmatrix} 0 \\ 0 \\ -\omega_{BC} \end{Bmatrix} \times \begin{Bmatrix} 0,32 \\ 0,24 \\ 0 \end{Bmatrix}} \quad \begin{Bmatrix} 0,24\,\omega_{BC} \\ -0,32\,\omega_{BC} \\ 0 \end{Bmatrix}$$

X-led ① $\quad 5 = 0,24\,\omega_{AB} + 0,24\,\omega_{BC}$

y-led ② $\quad 0 = 0,18\,\omega_{AB} - 0,32\,\omega_{BC}$

$\omega_{AB} = 13,33$ rad/s

$\omega_{BC} = 7,50$ rad/s

Svar: $\omega_{AB} = 13,3$ rad/s. $\omega_{BC} = 7,50$ rad/s

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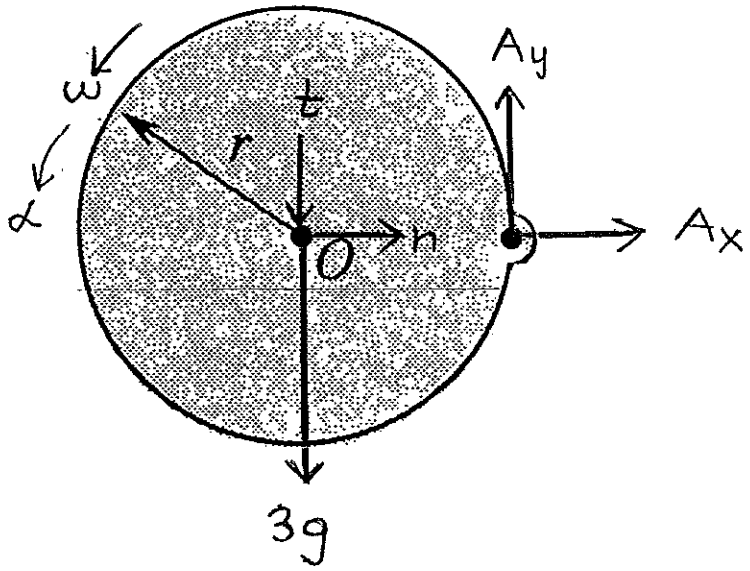


$\Sigma F_n = m a_n = m r \omega^2$ ①

$\Sigma F_t = m a_t = m r \alpha$ ②

$\Sigma M_A = I_A \alpha$ ③ $\quad I_A = \frac{1}{2} m r^2 + m r^2$

① $A_x = 3 \cdot 0{,}1 \cdot \omega^2$

② $3g - A_y = 3 \cdot 0{,}1 \cdot \alpha$

③ $\curvearrowleft A$ $3g \cdot 0{,}1 = \left(\frac{1}{2} \cdot 3 \cdot 0{,}1^2 + 3 \cdot 0{,}1^2\right) \cdot \alpha$

③ $\alpha = 65{,}4 \text{ rad/s}^2$

② $A_y = 9{,}81 \text{ N}$

Bestäm $\omega$ med energiekvationen.

$U = \Delta T + \Delta V_g + \Delta V_e$

$U = \Delta V_e = 0$

$\Delta T = \frac{1}{2} I_A \omega^2 - 0 = \frac{1}{2} \cdot \frac{3}{2} \cdot 3 \cdot 0{,}1^2 \cdot \omega^2 = 0{,}0225 \omega^2$

$\Delta V_g = -mgr = -3g \cdot 0{,}1 = -2{,}943 \text{ J}$

$0 = 0{,}0225 \omega^2 - 2{,}943 \Rightarrow \omega = 11{,}44 \text{ rad/s}$

① $A_x = 39{,}3 \text{ N}$

Svar: $A_x = 39{,}3 \text{ N}$ $A_y = 9{,}81 \text{ N}$

4)

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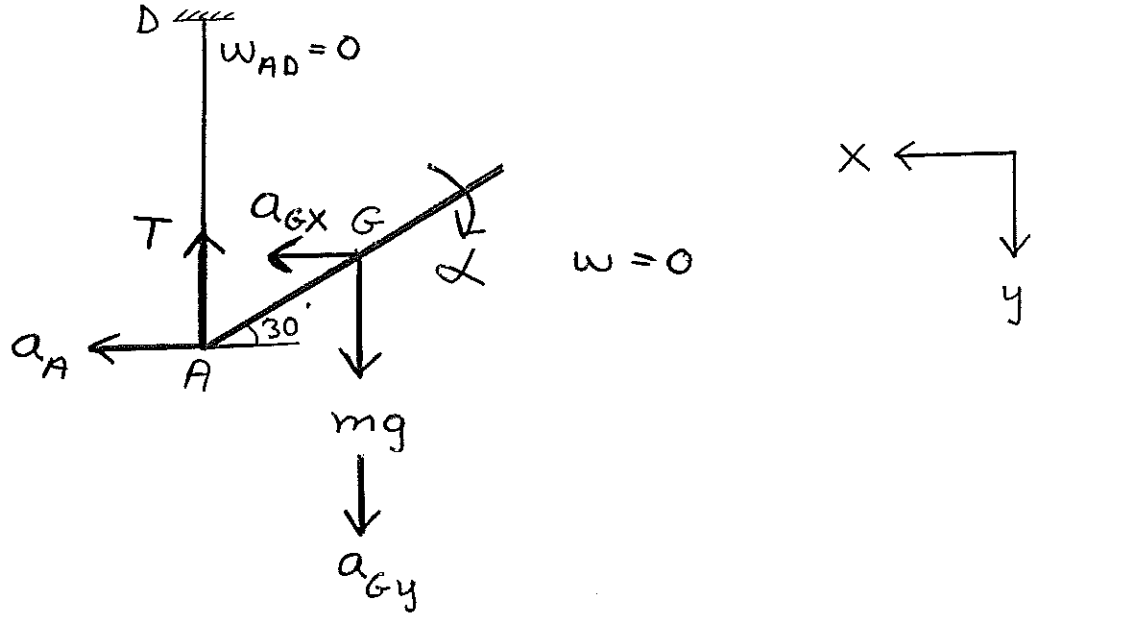


$\Sigma F_x = m a_{GX}$ ① $0 = m a_{GX} \Rightarrow a_{GX} = 0$

$\Sigma F_y = m a_{Gy}$ ② $mg - T = m a_{Gy}$

$\Sigma M_G = I_G \cdot \alpha$ ③ $T \cdot l \cdot \cos 30^\circ = \frac{1}{12} \cdot m \cdot 2^2 \cdot \alpha$

Bestäm $a_{Gy}$

$\overline{a_G} = \overline{a_A} + \overline{\alpha} \times \overline{AG}$ $(\overline{\omega} = \overline{0})$

$$\begin{Bmatrix} 0 \\ a_{Gy} \\ 0 \end{Bmatrix} = \begin{Bmatrix} a_A \\ 0 \\ 0 \end{Bmatrix} + \boxed{\begin{Bmatrix} 0 \\ 0 \\ -\alpha \end{Bmatrix} \times \begin{Bmatrix} -\cos 30^\circ \\ -\sin 30^\circ \\ 0 \end{Bmatrix}} \begin{Bmatrix} -\frac{1}{2}\alpha \\ \frac{\sqrt{3}}{2}\alpha \\ 0 \end{Bmatrix}$$

y-led ④ $a_{Gy} = \frac{\sqrt{3}}{2}\alpha$ insätter i ②

② $T = mg - m a_{Gy} = mg - m \cdot \frac{\sqrt{3}}{2}\alpha$

③ $\left(mg - m\frac{\sqrt{3}}{2}\alpha\right) \cdot \frac{\sqrt{3}}{2} = \frac{1}{12} \cdot m \cdot 4 \cdot \alpha$

$\frac{3\sqrt{3}}{2} g - \frac{9}{4}\alpha = \alpha$

$\alpha = \frac{6\sqrt{3}}{13} g \approx 7{,}84 \text{ rad/s}^2$

Svar: $\alpha = 7{,}84 \text{ rad/s}^2$

5)

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$\overline{\Omega}$ uider xyz

$$\overline{\Omega} = \begin{Bmatrix} 0 \\ \omega_{AB} \\ 0 \end{Bmatrix}$$

$$\overline{\omega} = \overline{\Omega} + \overline{P} = \begin{Bmatrix} 0 \\ \omega_{AB} \\ P \end{Bmatrix}$$

$$\Sigma \overline{M}_o = \left(\frac{d\overline{H}_o}{dt}\right)_{xyz} + \overline{\Omega} \times \overline{H}_o$$

$$\overline{H}_o = \overline{\overline{I}}_o \, \overline{\omega} = \begin{Bmatrix} - & 0 & 0 \\ - & I_{yy} & 0 \\ - & 0 & I_{zz} \end{Bmatrix} \begin{Bmatrix} 0 \\ \omega_{AB} \\ P \end{Bmatrix} = \begin{Bmatrix} 0 \\ I_{yy}\,\omega_{AB} \\ I_{zz}\,P \end{Bmatrix}$$

$$\Sigma \overline{M}_o = \overline{0} + \begin{Bmatrix} 0 \\ \omega_{AB} \\ 0 \end{Bmatrix} \times \begin{Bmatrix} 0 \\ I_{yy}\,\omega_{AB} \\ I_{zz}\,P \end{Bmatrix} = \begin{Bmatrix} I_{zz}\,P\,\omega_{AB} \\ 0 \\ 0 \end{Bmatrix}$$

$$\begin{Bmatrix} mg \cdot 2b - 2mgd \\ 0 \\ 0 \end{Bmatrix} = \begin{Bmatrix} I_{zz}\,P\,\omega_{AB} \\ 0 \\ 0 \end{Bmatrix}$$

$$mg \cdot 2b - 2mgd = I_{zz}\,P\,\omega_{AB}$$

$$\not{m} g \cdot 2b - 2\not{m} g d = \frac{1}{2}\not{m} b^2 P\,\omega_{AB}$$

$$d = b - \frac{b^2 P\,\omega_{AB}}{4g}$$

Svar: $d = b - \dfrac{b^2 P\,\omega_{AB}}{4g}$