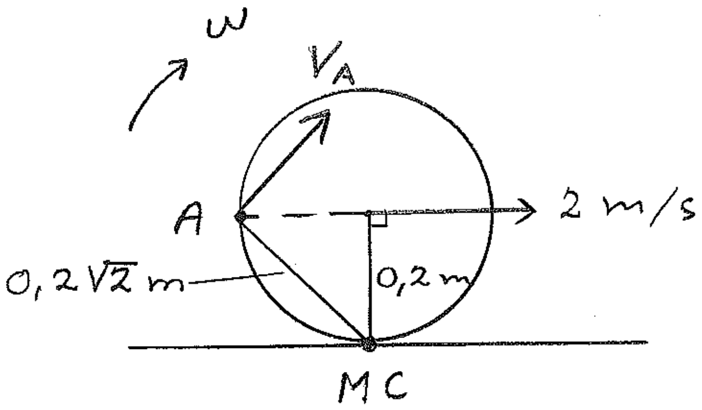
1a)



$V = \omega \cdot r$

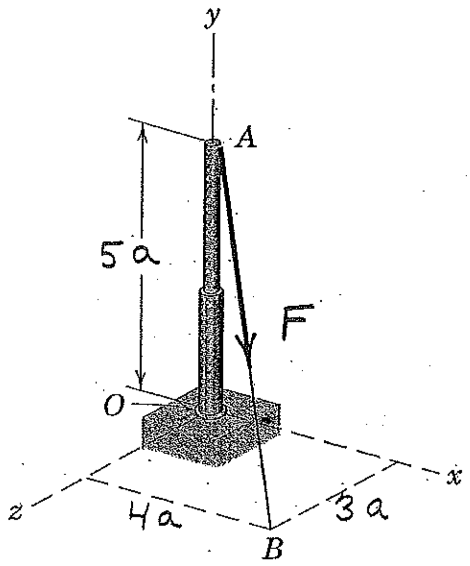
$2 = \omega \cdot 0,2 \quad \Rightarrow \quad \omega = 10 \text{ rad/s}$

$V_A = 10 \cdot 0,2\sqrt{2}$

$V_A = 2,83 \text{ m/s}$

Svar: $V_A = 2,83$ m/s

1b)



$$M_x = \overline{M}_o \circ \overline{i}$$

$$\overline{M}_o = \overline{r}_{OA} \times \overline{F}$$

$$\overline{r}_{OA} = 5a\overline{j}$$

$$\overline{F} = F\frac{\overline{AB}}{|\overline{AB}|} = F\frac{4a\overline{i} - 5a\overline{j} + 3a\overline{k}}{\sqrt{(4a)^2 + (5a)^2 + (3a)^2}} =$$

$$= \frac{F}{\sqrt{50}}\left(4\overline{i} - 5\overline{j} + 3\overline{k}\right)$$

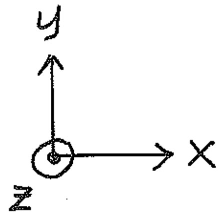
$$\overline{M}_o = \overline{r}_{OA} \times \overline{F} = \frac{F}{\sqrt{50}}\begin{vmatrix} \overline{i} & \overline{j} & \overline{k} \\ 0 & 5a & 0 \\ 4 & -5 & 3 \end{vmatrix} =$$

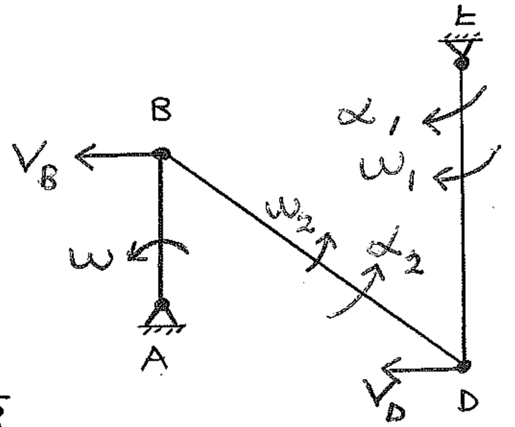
$$= \frac{Fa}{\sqrt{2}}\left(3\overline{i} - 4\overline{k}\right)$$

$$M_x = \frac{Fa}{\sqrt{2}}\begin{Bmatrix} 3 \\ 0 \\ -4 \end{Bmatrix} \circ \begin{Bmatrix} 1 \\ 0 \\ 0 \end{Bmatrix} = \frac{3Fa}{\sqrt{2}}$$

Svar: $M_x = \dfrac{3Fa}{\sqrt{2}}$

2)





$V_B = 2L\omega = 4L$

$V_D = 4L\omega_1$

$$\overline{V_B} = \overline{V_D} + \overline{\omega_2} \times \overline{DB}$$

$$\begin{Bmatrix} -4L \\ 0 \\ 0 \end{Bmatrix} = \begin{Bmatrix} -4L\omega_1 \\ 0 \\ 0 \end{Bmatrix} + \begin{Bmatrix} 0 \\ 0 \\ \omega_2 \end{Bmatrix} \times \begin{Bmatrix} -4L \\ 3L \\ 0 \end{Bmatrix} = \begin{Bmatrix} -4L\omega_1 - 3L\omega_2 \\ -4L\omega_2 \\ 0 \end{Bmatrix}$$

x-led $\quad -4L = -4L\omega_1 - 3L\omega_2 \Rightarrow \underline{\omega_1 = 1 \text{ rad/s}}$

y-led $\quad 0 = -4L\omega_2 \Rightarrow \underline{\omega_2 = 0}$

$$\overline{a_B} = \overline{a_D} + \overline{\alpha_2} \times \overline{DB} + \overline{\omega_2} \times (\overline{\omega_2} \times \overline{DB})$$

$\overline{a_B} \quad a_t = r \cdot \alpha = 2L \cdot 0 = 0$

$\quad a_n = r\omega^2 = 2L \cdot 2^2 = 8L$

$\overline{a_D} \quad a_t = r\alpha = 4L \cdot \alpha_1$

$\quad a_n = r\omega^2 = 4L \cdot \omega_1^2 = 4L \cdot 1^2 = 4L$

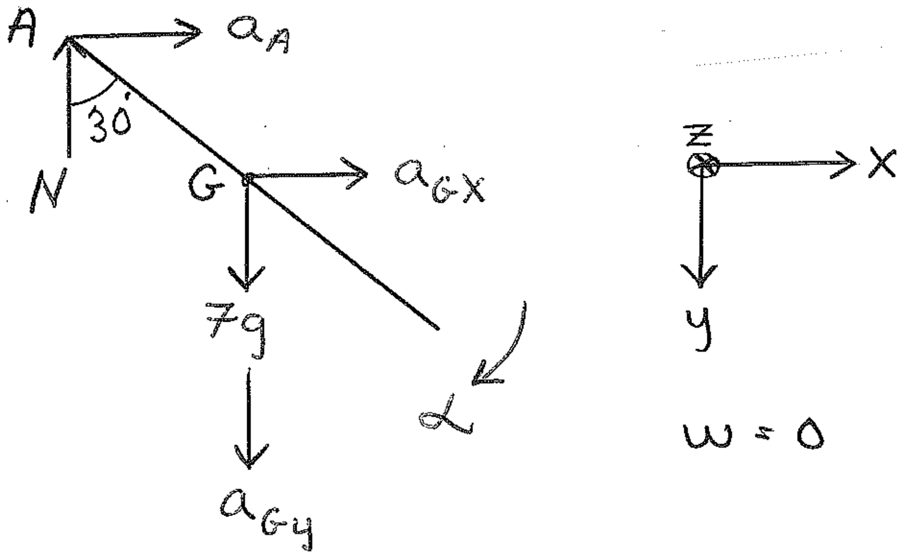
$$\begin{Bmatrix} 0 \\ -8L \\ 0 \end{Bmatrix} = \begin{Bmatrix} -4L\alpha_1 \\ 4L \\ 0 \end{Bmatrix} + \begin{Bmatrix} 0 \\ 0 \\ \alpha_2 \end{Bmatrix} \times \begin{Bmatrix} -4L \\ 3L \\ 0 \end{Bmatrix} = \begin{Bmatrix} -4L\alpha_1 - 3L\alpha_2 \\ 4L - 4L\alpha_2 \\ 0 \end{Bmatrix}$$

y-led $\quad -8L = 4L - 4L\alpha_2$

$\quad \alpha_2 = 3 \text{ rad/s}^2$

<u>Svar: $\omega_2 = 0$, $\alpha_2 = 3 \text{ rad/s}^2$</u>

3/



$$\overline{a}_G = \overline{a}_A + \overline{\alpha} \times \overline{AG} + \overline{\omega} \times (\overline{\omega} \times \overline{AG})$$

$$\overline{a}_G = \begin{Bmatrix} a_A \\ 0 \\ 0 \end{Bmatrix} + \begin{Bmatrix} 0 \\ 0 \\ \alpha \end{Bmatrix} \times \begin{Bmatrix} 0{,}6 \sin 30° \\ 0{,}6 \cos 30° \\ 0 \end{Bmatrix}$$

$$\overline{a}_G = \begin{Bmatrix} a_A - 0{,}6 \cos 30° \cdot \alpha \\ 0{,}6 \sin 30° \cdot \alpha \\ 0 \end{Bmatrix}$$

$$a_{Gy} = 0{,}3\alpha$$

$\Sigma F_y = m a_{Gy}$ ① $7g - N = 7 \cdot 0{,}3\alpha$

$\Sigma M_G = I_G \alpha$ $\overset{\curvearrowright}{G}$ ② $N \cdot 0{,}6 \sin 30° = \frac{1}{12} \cdot 7 \cdot 1{,}2^2 \cdot \alpha$

① $N = 7g - 2{,}1\alpha$

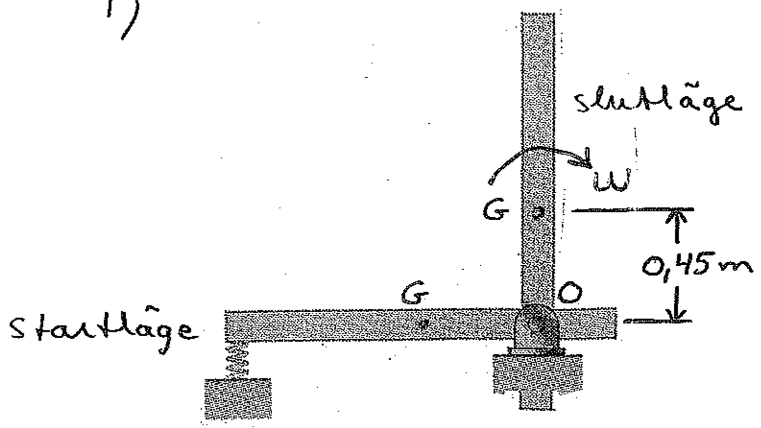
② $(7g - 2{,}1\alpha) \cdot 0{,}3 = 0{,}84\alpha$

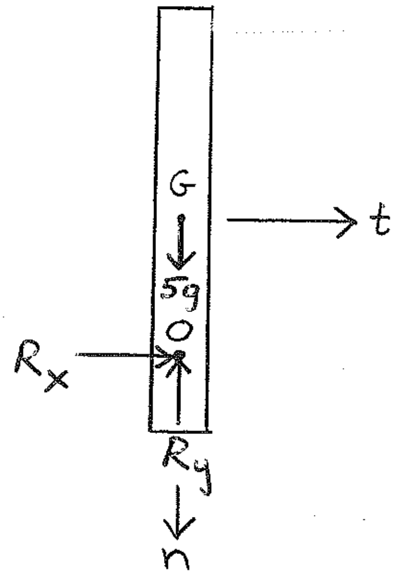
$\alpha = 14{,}01 \text{ rad/s}^2$

① $N = 39{,}2$ Newton

Svar: $\alpha = 14{,}0 \text{ rad/s}^2$. $N = 39{,}2$ Newton

4)





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

$U = 0$

$\Delta T = \frac{1}{2} I_o \omega^2 - 0 = \frac{1}{2}(I_G + md^2)\omega^2 =$

$= \frac{1}{2}\left(\frac{1}{12} m l^2 + m d^2\right)\omega^2 = \frac{1}{2}\left(\frac{1}{12} \cdot 5 \cdot 1{,}5^2 + 5 \cdot 0{,}45^2\right)\omega^2 = 0{,}975\,\omega^2$

$\Delta V_g = mgh = 5g \cdot 0{,}45 = 22{,}072\ \text{J}$

$\Delta V_e = 0 - \frac{1}{2} k x^2 = 0 - \frac{1}{2} \cdot 200 \cdot 10^3 \cdot 0{,}02^2 = -40\ \text{J}$

$0 = 0{,}975\,\omega^2 + 22{,}072 - 40$

$\omega = 4{,}288\ \text{rad/s}$

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① $\Sigma F_t = m a_t = m \cdot r \alpha$

② $\Sigma F_n = m a_n = m r \omega^2$

③ $\Sigma M_O = I_O \cdot \alpha$

① $R_x = 5 \cdot 0{,}45\,\alpha$

② $5g - R_y = 5 \cdot 0{,}45 \cdot 4{,}288^2$

③ $0 = I_O \cdot \alpha$

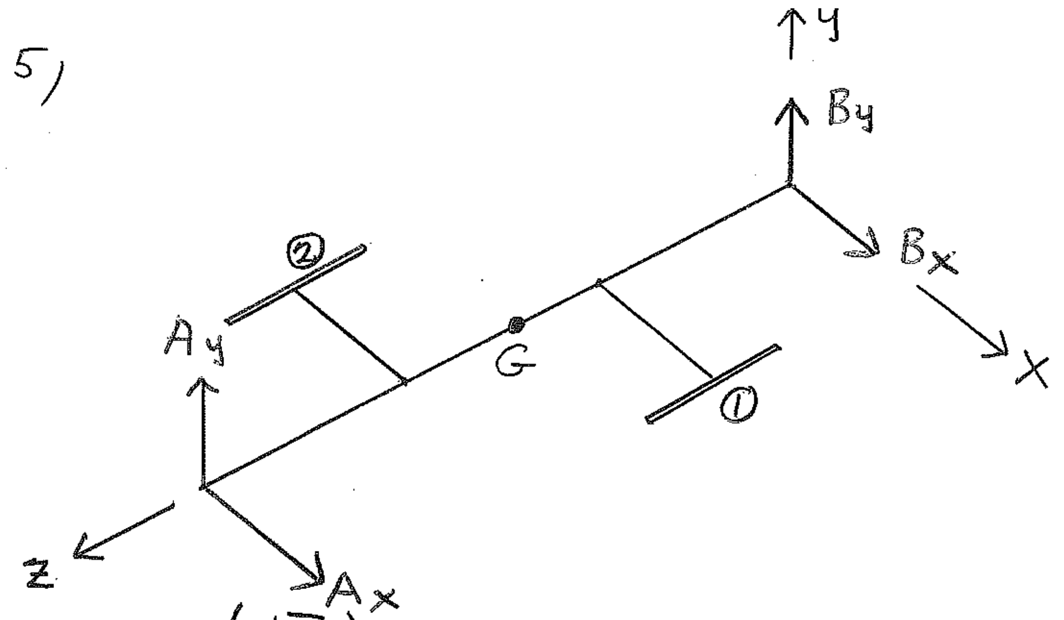
③ $\alpha = 0$

① $R_x = 0$

② $R_y = 7{,}679\ \text{N}$

Svar: $R_x = 0 \quad R_y = 7{,}68\ \text{N}$

5)



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

$$\overline{H}_A = \overline{I}_A\,\overline{\omega} = \begin{Bmatrix} - & - & -I_{xz} \\ - & - & -I_{yz} \\ - & - & I_{zz} \end{Bmatrix} \begin{Bmatrix} 0 \\ 0 \\ -\omega \end{Bmatrix} = \begin{Bmatrix} I_{xz}\,\omega \\ I_{yz}\,\omega \\ -I_{zz}\,\omega \end{Bmatrix}$$

$$\begin{Bmatrix} B_y \cdot 3b \\ -B_x \cdot 3b \\ 0 \end{Bmatrix} = \overline{0} + \begin{Bmatrix} 0 \\ 0 \\ -\omega \end{Bmatrix} \times \begin{Bmatrix} I_{xz}\,\omega \\ I_{yz}\,\omega \\ -I_{zz}\,\omega \end{Bmatrix} = \begin{Bmatrix} I_{yz}\,\omega^2 \\ -I_{xz}\,\omega^2 \\ 0 \end{Bmatrix}$$

① $B_y \cdot 3b = I_{yz}\,\omega^2$

② $-B_x \cdot 3b = -I_{xz}\,\omega^2$

① $B_y = 0$

② $B_x = -\frac{1}{3} m b \omega^2$

$I_{yz} = 0$ (symmetri)

$I_{xz} = I_{xzG} + m\,d_x\,d_z$

$I_{xz} = \underbrace{(0 + m \cdot b \cdot b)}_{①} + \underbrace{(0 + m \cdot (-b) \cdot 2b)}_{②}$

$I_{xz} = -mb^2$

$\Sigma \overline{F} = m\,\overline{a}_G = \overline{0}$

③ $A_x + B_x = 0 \qquad A_x = -B_x = \frac{1}{3} m b \omega^2$

④ $A_y + B_y = 0 \qquad A_y = -B_y = 0$

Svar: $A_x = \frac{1}{3} m b \omega^2 \qquad B_x = -\frac{1}{3} m b \omega^2$

$A_y = B_y = 0$