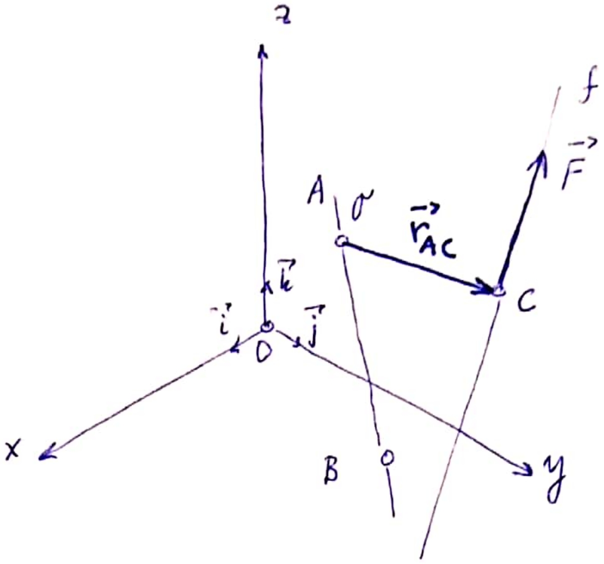
Moment síly k obecné ose



Dáno:

Síla $\vec{F}(F_x, F_y, F_z)$

$F_x = 10N$; $F_y = 20N$; $F_z = 40N$

Působiště síly

$C[x_C, y_C, z_C]$ $x_C = 8m$

$y_C = 11m$

$z_C = 10m$

Obecná osa o:

$A[x_A, y_A, z_A]$ $x_A = 2m$

$y_A = 3m$

$z_A = 4m$

$B[x_B, y_B, z_B]$ $x_B = 5m$

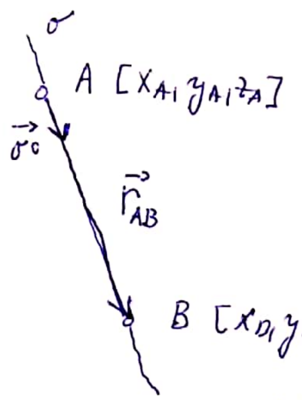
$y_B = 6m$

$z_B = 7m$

Určete:

Moment síly $\vec{F}$ k ose o

1) jednotkový vektor osy o



$\vec{r}_{AB} = (x_B - x_A, y_B - y_A, z_B - z_A) =$

$= (5-2, 6-3, 7-4) = (3, 3, 3)\,m$

normalizace vektoru $\vec{r}_{AB}$

velikost vektoru $\vec{r}_{AB}$

$r_{AB} = \sqrt{3^2 + 3^2 + 3^2} = \sqrt{27} \doteq 5{,}2\,m$

$$\vec{o}^{\circ} = \frac{\vec{r}_{AB}}{r_{AB}} = \frac{3}{5{,}2}\vec{i} + \frac{3}{5{,}2}\vec{j} + \frac{3}{5{,}2}\vec{k} =$$

$$= \underbrace{0{,}577}_{\cos\alpha_o}\vec{i} + \underbrace{0{,}577}_{\cos\beta_o}\vec{j} + \underbrace{0{,}577}_{\cos\gamma_o}\vec{k}$$

2) Moment síly k bodu, který leží na ose o

$$\vec{M}_A = \vec{r}_{AC} \times \vec{F} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ x_{AC} & y_{AC} & z_{AC} \\ F_x & F_y & F_z \end{vmatrix} =$$

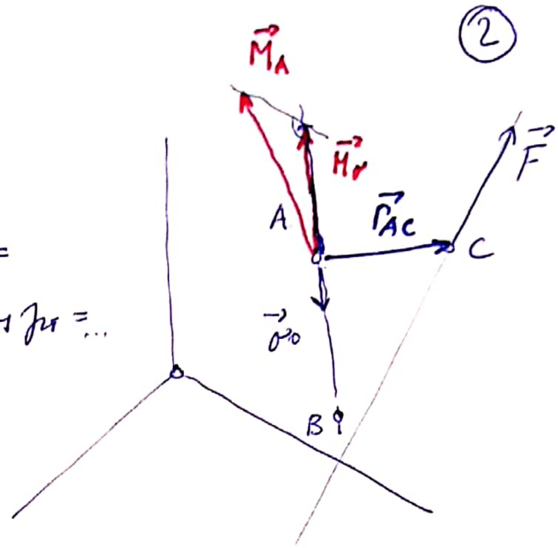
②

$$\vec{M}_A = M_{Ax}\,\vec{i} + M_{Ay}\,\vec{j} + M_{Az}\,\vec{k}$$

$$M_o = \vec{M}_A \cdot \vec{o}^{\,o} = (M_{Ax}, M_{Ay}, M_{Az}) \cdot (\cos\alpha_o, \cos\beta_o, \cos\gamma_o) =$$

$$= M_{Ax} \cdot \cos\alpha_o + M_{Ay}\cos\beta_o + M_{Az}\cos\gamma_o = \dots$$

$$\vec{M}_o = M_o \cdot \vec{o}^{\,o}$$



Smíšený součin:

$$M_o = \vec{o}^{\,o} \cdot \vec{M}_A = \vec{o}^{\,o} \cdot (\vec{r}_{AC} \times \vec{F}) = \begin{vmatrix} \cos\alpha_o & \cos\beta_o & \cos\gamma_o \\ x_{AC} & y_{AC} & z_{AC} \\ F_x & F_y & F_z \end{vmatrix} =$$

$$= \cos\alpha_o (y_{AC} \cdot F_z - z_{AC} \cdot F_y) - \cos\beta_o (x_{AC} \cdot F_z - z_{AC} \cdot F_x) +$$

$$+ \cos\gamma_o (x_{AC} F_y - y_{AC} F_x) = \dots\dots$$

$$\vec{M}_o = M_o \cdot \vec{o}^{\,o} = \dots$$

$$x_{AC} = x_C - x_A = \dots$$

$$y_{AC} = y_C - y_A = \dots$$

$$z_{AC} = z_C - z_A = \dots$$

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