Mech 2: 22 augustus 2007 S.R. Kisoensingh ①

2b, 2d

Opgave 1)

$\frac{1}{2} \leq \alpha \leq 1$

a) $I_c = I_{staaf} = \frac{1}{12} m l^2$

b) $\Sigma M_i = \Sigma I \alpha$

c)

d)

Opgave 2)

a) Er zijn geen externe krachten. Er zijn geen eigen krachten die o/d balk werken dus $\Sigma M_c = 0$ en $M = \frac{dL}{dt}$ dus $L = \text{constant}$ (behouden

b) $\Sigma L_{voor} = \Sigma L_{na}$; t.o.v. C

$$r_{mk} m_K V_K + \underbrace{I_{mk}}_{\substack{\text{geen rot} \\ = 0}} \omega_K = \underbrace{r_{tov\,C} (m_K + m_b) V_c}_{\substack{=0 \text{ (vaste as)} \\ \text{dus geen translatie}}} + \underbrace{I_{(b+k)}}_{\text{Steiner}} \omega_{(b+k)}$$

~~geen translatie~~

$$d\, m_k V_k = d (m_K + m_b) V_c + I_{(b+k)} \cdot \omega_{b+k}$$

$\cdot\; I_{(b+k)} = I_b + m s^2$

$= I_b + (m_K + m_b) s^2$

$= \frac{1}{12} m_b l^2 + (m_K \cancel{+m_b}) d^2$

↑ 0 vaste as

$$d\, m_K V_K = \cancel{d(m_K+m_b)V_c} + \left(\frac{1}{12} m l^2 + (m_K + m_b) d^2\right) \omega$$

$$\left(\frac{1}{12} m l^2 + (m_K + m_b) d^2\right) \omega = d\, m_K V_K \cancel{- d(m_K+m_b)V_c}$$

$$\omega = \cancel{\frac{d m_K V_K - d(m_K + m_b) V_c}{\frac{1}{12} m_b l^3 + (m_K + m_b) d^2}}$$

$$\omega = \frac{d\, m_K V_K}{\frac{1}{12} m_b l^2 + (m_K \cancel{+m_b}) d^2}$$

dus blijft
hij blijft rotoren om C dus geen nieuwe mmp. $I_{tot} = I_b + I_{kogel}$

$= \frac{1}{12} m l^2 + m_K d^2$

indien geen vaste as dan Steiner en beide massa's optellen t.o.v. nieuwe mmp τ

c) $\Sigma U_{k\,\text{voor}} = \frac{1}{2} m_k (V_k)^2$

$\Sigma U_{k\,\text{na}} = \underbrace{\frac{1}{2}(m_k + m_b)(V_c)^2}_{\substack{0 \\ \text{(vast an)}}} + \frac{1}{2} I_{b+k}\, \omega^2$ $\left.\begin{matrix} = \frac{1}{2} m_k (V_k)^2 \\ = \frac{1}{2} I_{b+k}\, \omega^2 \end{matrix}\right.$

$U_{k\,\text{na}} < U_{k\,\text{voor}}$
Verlies aan warmte tijdens de botsing.

d) $S = \Delta p = m \Delta V = P_{na} - P_{voor}$

$\Delta V = \underbrace{V_{c\,na}}_{\text{0 (geen translatie)}} - V_K$

→ ?

$\underbrace{P_{na}}_{\text{0 geen translatie}} - P_{voor} = S \iff P_{voor} = m_K V_K$ dus $S = -m_K V_K$

<u>Opgave 3</u>

$x(0) = 0$
$\dot{x}(0) = 0$

a) $m x'' + r x' + b x = -F$

b) $x(t) = x_s$ en $x_s < 0$ $\iff F = -b \cdot x_s \Rightarrow x_s = -\frac{F}{b}$

$\cancel{x(t) = A e^{-\alpha t} \cos(\omega_1 t + \beta)}$

c) $x(t) = A e^{-\alpha t} \cos(\omega_1 t + \beta) - \frac{F}{b}$

d) $x(0) = 0 \iff 0 = A e^0 \cos(0 + \beta) - \frac{F}{b} \iff \boxed{A \cos\beta - \frac{F}{b} = 0}\ I$

$x'(0) = 0 \iff x'(t) = A\{e^{-\alpha t} - \sin(\omega_1 t + \beta)\,\omega_1 + -\alpha e^{-\alpha t} \cos(\omega_1 t + \beta)\}$

$= A\{-\omega_1 e^{-\alpha t} \sin(\omega_1 t + \beta) - \alpha e^{-\alpha t} \cos(\omega_1 t + \beta)\}$

$x'(0) = 0,$

$0 = A\{-\omega_1 \sin\beta - \alpha \cos\beta\}$

$-\omega_1 \sin\beta - \alpha\cos\beta = 0$

$(\sin\beta - \cos\beta)(-\omega_1 - \alpha) = 0$