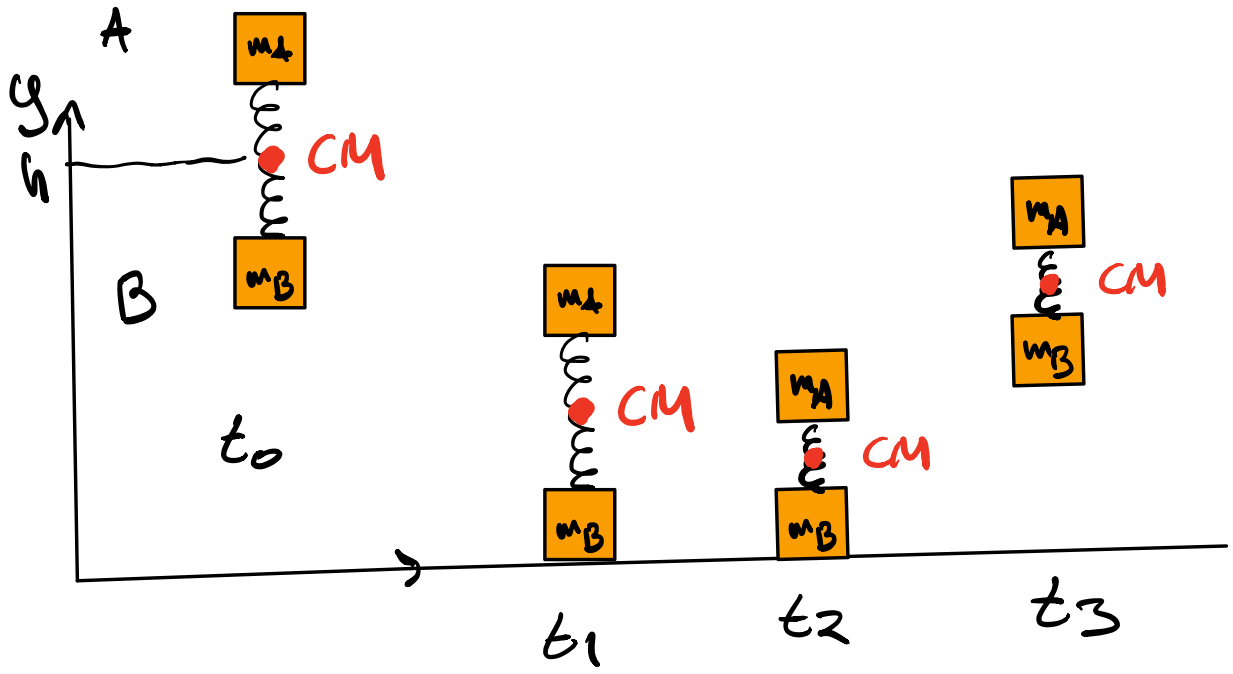
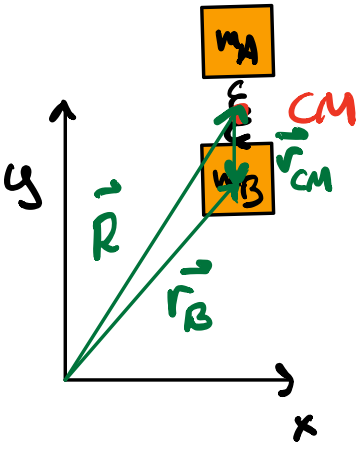
Energi i flerpartikkelsystem



Kinetisk Energi



$$K = \frac{1}{2} m_A v_A^2 + \frac{1}{2} m_B v_B^2$$

Mange partikler

$$K = \sum \frac{1}{2} m_i (\vec{v}_i)^2$$

$$K = \sum \frac{1}{2} m_i \left(\frac{d\vec{r}_i}{dt}\right)^2$$

$$\vec{r}_i = \vec{R} + \vec{r}_{cm\,i}$$

$$K = \sum \frac{1}{2} m_i \left(\frac{d}{dt} \left(\vec{R} + \vec{r}_{cm\,i} \right) \right)^2$$

$$\sum \frac{1}{2} m_i \left(\frac{d\vec{R}}{dt} \right)^2 + \frac{1}{2} m_i \left(\frac{d\vec{r}_{cm\,i}}{dt} \right)^2$$

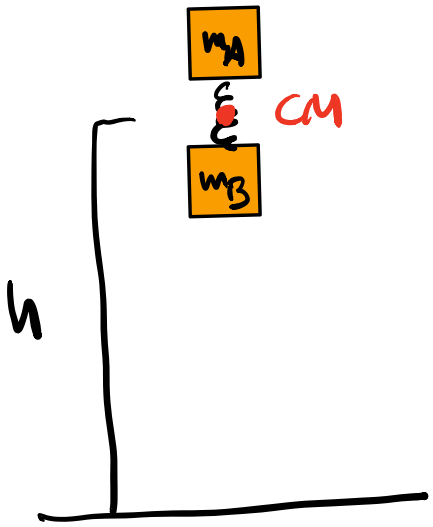
Kinetisk energi til massesenter

K_{CM}

Kinetisk energi i forhold til massesenter.

$K_{\neq CM}$

Potensiell energi



$$U_{TOT} = U_{ext} + U_{int}$$

$$U_{ext} = (m_A + m_B) \cdot g \cdot h$$

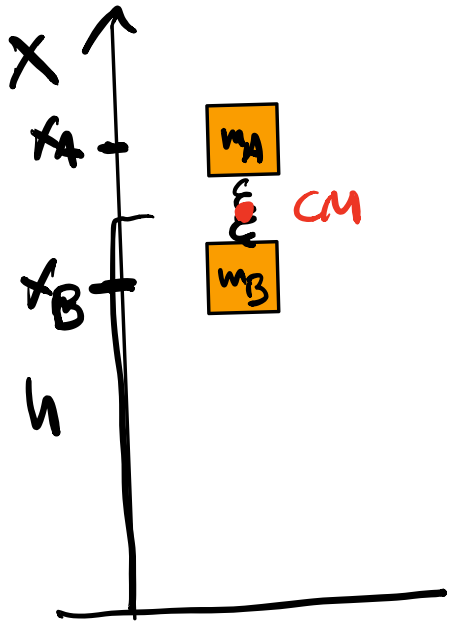
(Gravitasjon)

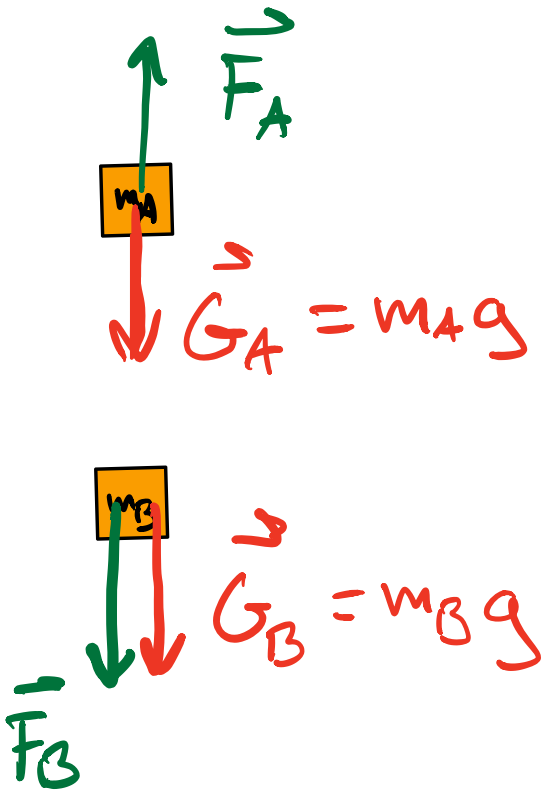
$$U_{int} = \frac{1}{2} K (\Delta x)^2$$

Energi i fjær

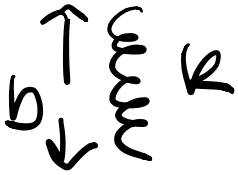
Energibevaring:

$$E = K_{CM} + U_{ext} + K_{\Delta CM} + U_{int}$$





Fjæren har lengde b og fjærkonstant, k.



$$F_A = -k\Delta L$$

$$\Delta L = (x_A - x_B - b)$$

$$F_A = -k(x_A - x_B - b)$$

N.3.lov

$$F_B = -F_A = k(x_A - x_B - b)$$

N.2. lov Kloss A

$$m_A \cdot a_A = -k(x_A - x_B - b) - m_A g$$

$$a_A = -\frac{k}{m}(x_A + x_B - b) - g$$

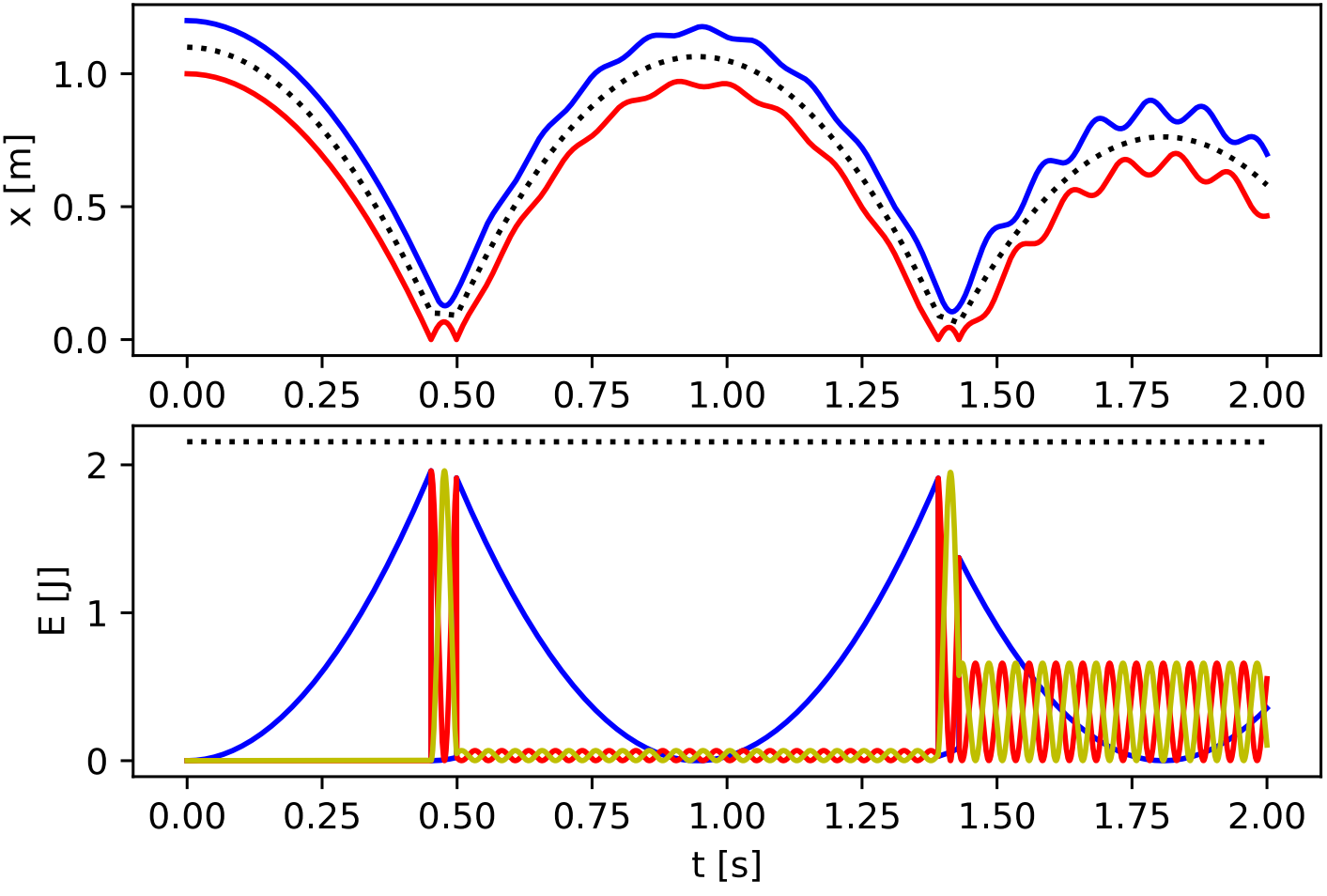
N. 2. lov Kloss B

$$m_B \cdot a_B = k(x_A - x_B - b) - m_B g$$

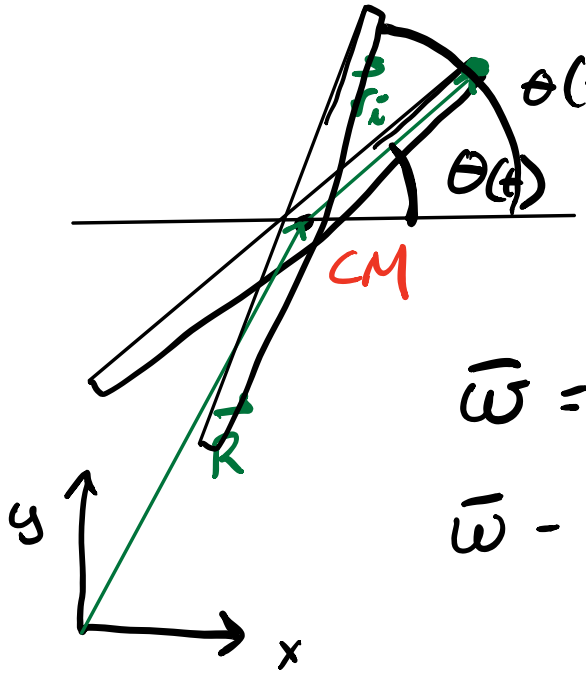
$$a_B = \frac{k}{m}(x_A - x_B - b) - g$$

$x_A(0) = 1{,}2\,m$ $\quad v_A(0) = 0$

$x_B(0) = 1{,}0\,m$ $\quad v_B(0) = 0$


x [m]
1.0
0.5
0.0
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
E [J]
2
1
0
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
t [s]

Rotasjon Kap 14



$$\bar{\omega} = \frac{\theta(t+\Delta t) - \theta(t)}{\Delta t}$$

$\bar{\omega}$ - vinkel hastighet (gjennomsnitt)

$\theta(t)$ - vinkel [rad]

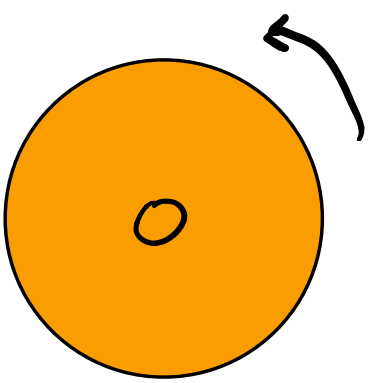
$\omega = \frac{d}{dt}\theta(t)$ - vinkel-hastighet [rad/s]

$\alpha = \frac{d}{dt}\omega(t) = \frac{d^2}{dt^2}\theta(t)$ - vinkel akselerasjon [rad/s^2]

Eks DVD

Vinkelakselerasjon

$2{,}0\ \text{rad/s}^2$



Hvor mange runder snurrer DVD-en på 10s?

$$\alpha = 2{,}0\ \text{rad/s}^2$$

$$\alpha = \dot{\omega} = \omega'' = \frac{d^2}{dt^2}\theta$$

$$\omega = \int_0^t \alpha\, dt = \int_0^t 2{,}0\ \text{rad/s}^2\, dt$$

$$\omega = \alpha \cdot t + C$$

DVD starter i ro. Dvs. $\omega(0) = 0$

$$\Rightarrow C = 0$$

$$\omega = \alpha t$$

$$\theta = \int \omega\, dt = \int \alpha t\, dt = \frac{1}{2}\alpha t^2 + D$$

$\theta(0) = 0 \Rightarrow D = 0$

$$\theta(t) = \frac{1}{2}\alpha \cdot t^2$$

$$\theta(t) = \frac{1}{2} \cdot 2{,}0\ \text{rad/s}^2 \cdot t^2$$

$$\theta(10\text{s}) = \frac{1}{2} \cdot 2{,}0\ \text{rad/s}^2\ (10\text{s})^2$$

$$\theta(10\text{s}) = 100\ \text{rad}$$

En runde er 2π radianer

$$\frac{100\ \text{rad}}{2\pi\ \text{rad/runde}} = 16\ \text{runder}$$