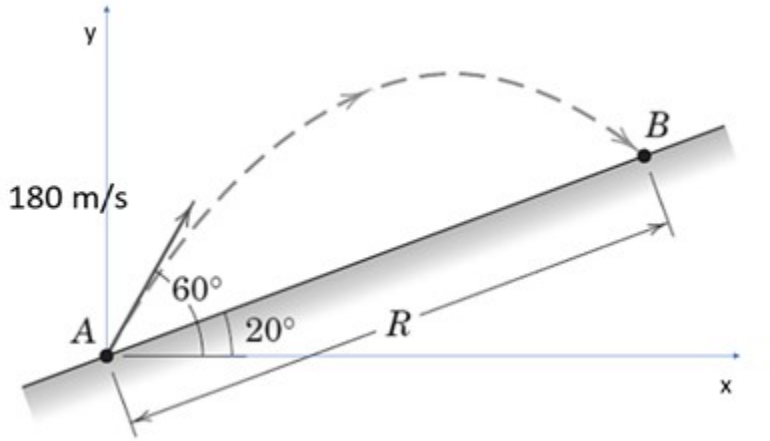
Opgave 1



$g := 9.81$

a) $v_y := 180 \cdot \sin(60\ \mathit{deg}) = 155.885$

$\Delta V := m \cdot g \cdot y_{max}$

$\Delta T := -\frac{1}{2} \cdot m \cdot v_y^{\,2}$

$\Delta V + \Delta T = 0 \xrightarrow[float,4]{solve,\, y_{max}} 1239.0$ $\qquad y_{max} := 1239.0\ m$

b) Banekurven y(x):

$x = 180 \cdot \cos(60\ \mathit{deg}) \cdot t \xrightarrow{solve,\, t} \frac{x}{180 \cdot \cos(60 \cdot deg)}$

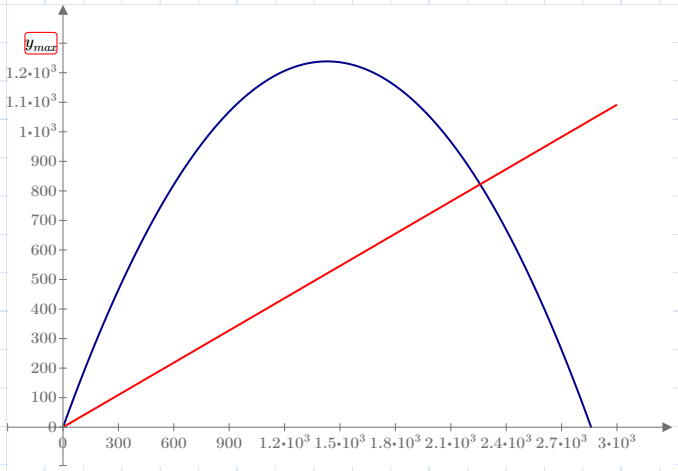
$y = 180 \cdot \sin(60\ \mathit{deg}) \cdot t - \frac{1}{2} \cdot g \cdot t^2 \xrightarrow[expand\ float,4]{substitute,\, t = \frac{x}{180 \cdot \cos(60 \cdot deg)}} y = \frac{0.5 \cdot x \cdot \sin(120.0 \cdot deg)}{\cos(60.0 \cdot deg)^2} - \frac{0.0001514 \cdot x^2}{\cos(60.0 \cdot deg)^2}$

$y(x) := -6.056 \cdot 10^{-4} \cdot x^2 + 1.732 \cdot x$

Den skrå rampe har forskriften:

$$y1(x) := \tan(20\ deg) \cdot x \qquad \tan(20\ deg) = 0.364$$

Plot af banekurven og den skrå rampe:



c) Afstanden R:

$$y(x) = y1(x) \xrightarrow[float,4]{solve,x} \begin{bmatrix} 0 \\ -1651.0 \cdot \tan(20.0 \cdot deg) + 2860.0 \end{bmatrix}$$

$$x := -1651.0 \cdot \tan(20.0 \cdot deg) + 2860.0 = 2.259 \cdot 10^3$$

Da x=Rcos(20 deg):

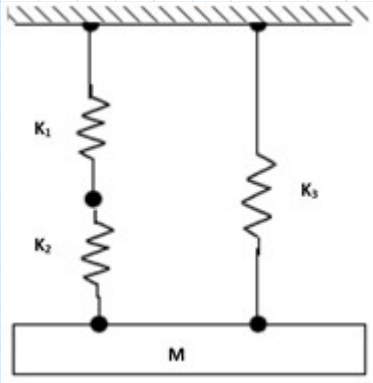
$$R \cdot \cos(20\ deg) = 2.259 \cdot 10^3 \xrightarrow{solve,R} \frac{2259.0}{\cos(20.0 \cdot deg)}$$

$$R := \frac{2259.0}{\cos(20.0 \cdot deg)} = 2.404 \cdot 10^3$$

$R := 2404\ m$

Opgave 3

a) ækvivalent fjederstivhed



Fjederstivhed for de seriekoblede fjedre:

$$\frac{1}{K_{12}} = \frac{1}{K_1} + \frac{1}{K_2} \xrightarrow[simplify]{solve, K_{12}} \frac{K_1 \cdot K_2}{K_1 + K_2}$$

Fjederstivhed for de således parallelkoblede fjedre:

$$K_{123} = K_{12} + K_3$$

Data: $K_1 := 10$ $K_2 := 6$ $K_3 := 10$ $M := 1$

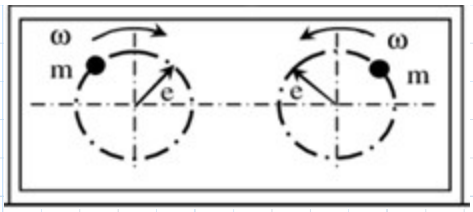
$$K_{123} := \frac{K_1 \cdot K_2}{K_1 + K_2} + K_3 = 13.75$$

Egenfrekvens:

$$\omega_1 := \sqrt{\frac{K_{123}}{M}} = 3.708$$

$$\omega_1 := 3.708 \ \frac{rad}{s} = 35.409 \ \frac{rev}{min}$$

b) lodret kraftkomposant:



$m_1 := 0.05 \qquad \omega := 10 \qquad e := 0.01$

Narmalacc. i cirkelbevægelse: $a_n := e \cdot \omega^2 = 1$

Normalkraft pr. masse: $F_n := m_1 \cdot a_n = 0.05$

Lodret kraftkomposant: $F_L(t) := 2 \cdot F_n \cdot \sin(\omega \cdot t) \rightarrow 0.1 \cdot \sin(10 \cdot t)$

$F_L(t) := 0.1 \cdot \sin(10 \cdot t)\ N$

c) lodret kraftkomposant når $\omega = \omega_1$:

$m_1 := 0.05 \qquad \omega := 3.708 \qquad e := 0.01$

acc. i cirkelbevægelse: $a_n := e \cdot \omega^2 = 0.137$

kraft pr. masse: $F_n := m_1 \cdot a_n = 0.007$

Lodret kraftkomposant:

$F_L(t) := 2 \cdot F_n \cdot \sin(\omega \cdot t) \xrightarrow{float, 4} 0.01375 \cdot \sin(3.708 \cdot t)$

$F_L(t) := 0.01375 \cdot \sin(3.708 \cdot t) \cdot N$

Den lodrette kraftpåvirkning bliver således:

$$\frac{0.01375}{0.1} = 0.138$$

gange mindre, men fører til resonans i systemet, hvorved der opstår stor risiko for at fjedrene deformeres kraftigt og konstruktionen ødelægges.