$m_1 = 1\ \text{kg};$ $\vec{v}_1 = (4,0,0)\ \text{m/s};$ $\vec{r}_1 = (0,0,2.5)\ \text{m}$
$m_2 = 0.5\ \text{kg};$ $\vec{v}_2 = (1,0,0)\ \text{m/s};$ $\vec{r}_2 = (0,0,2.2)\ \text{m}$

$$\vec{r}_{sp} = \frac{m_1 r_1 + m_2 r_2}{m_1 + m_2} = \begin{pmatrix} 0 \\ 0 \\ 2.4\ \text{m} \end{pmatrix}$$

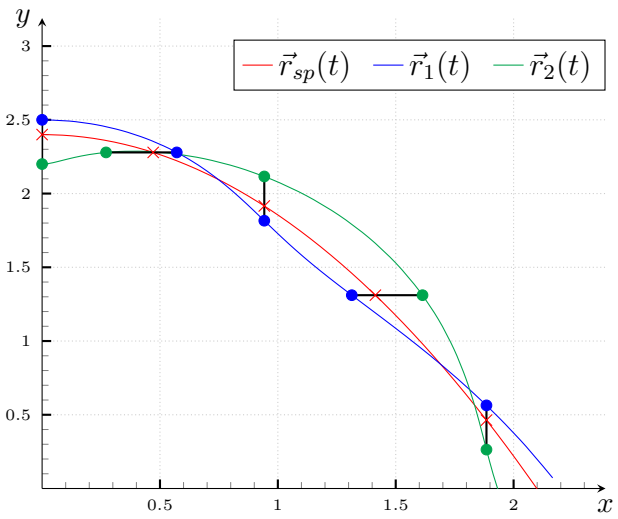
a) Im bewegten Bezugssystem, das sich mit $3\ \text{m/s}$ mitbewegt reine Rotation

$$\Rightarrow \vec{r}_{sp}(t) = \begin{pmatrix} 0 \\ 0 \\ 2.4\ \text{m} \end{pmatrix} + \begin{pmatrix} 3\ \text{m/s} \\ 0 \\ 0 \end{pmatrix} t + \frac{1}{2} \begin{pmatrix} 0 \\ 0 \\ -9.81\ \text{m/s}^2 \end{pmatrix} t^2$$

b) Im bewegten Bezugssystem: $\vec{v}_1 = (1,0,0)\ \text{m/s};\ \vec{v}_1 = (-2,0,0)\ \text{m/s}$

$\omega = \frac{|v_1|}{r_1} = \underline{10\ \text{s}^{-1}}$
$T = \frac{2\pi}{\omega} = \frac{\pi}{5} = \underline{0.63\ \text{s}}$

c)




d) Im Schwerpunktsystem:

$$\vec{r}_{1,sp}(t) = 0.1 \begin{pmatrix} \sin(\omega t) \\ 0 \\ \cos(\omega t) \end{pmatrix}\ \text{m}$$

$$\vec{r}_{2,sp}(t) = -0.2 \begin{pmatrix} \sin(\omega t) \\ 0 \\ \cos(\omega t) \end{pmatrix}\ \text{m}$$

Im Laborsystem:

$$\vec{r}_1(t) = \vec{r}_{sp}(t) + \vec{r}_{1,sp}(t)$$
$$= \underline{\underline{\begin{pmatrix} 0.1\sin(\omega t)\ \text{m} \\ 0 \\ 0.1\cos(\omega t)\ \text{m} + 2.4\ \text{m} \end{pmatrix} + \begin{pmatrix} 3\ \text{m/s} \\ 0 \\ 0 \end{pmatrix} t + \frac{1}{2} \begin{pmatrix} 0 \\ 0 \\ -9.81\ \text{m/s}^2 \end{pmatrix} t^2}}$$

$$\vec{r}_2(t) = \vec{r}_{sp}(t) + \vec{r}_{2,sp}(t)$$
$$= \underline{\underline{\begin{pmatrix} -0.2\sin(\omega t)\ \text{m} \\ 0 \\ -0.2\cos(\omega t)\ \text{m} + 2.4\ \text{m} \end{pmatrix} + \begin{pmatrix} 3\ \text{m/s} \\ 0 \\ 0 \end{pmatrix} t + \frac{1}{2} \begin{pmatrix} 0 \\ 0 \\ -9.81\ \text{m/s}^2 \end{pmatrix} t^2}}$$

# 140. International Space Station

$$R_E = 6.37 * 10^6\ \text{m}; \quad m = 4.55 * 10^5\ \text{kg}; \quad h = 3.3 * 10^5\ \text{m}$$

a) $h = 0\ \text{m}$

$$F_G = mg\frac{1}{\left(1+\frac{h}{R_E}\right)^2}$$
$$= 4.55 * 10^5\ \text{kg} * 9.81\ \text{m/s}^2$$
$$F_G = \underline{\underline{4.46 * 10^6\ \text{kg m/s}^2}}$$

b) $h = 3.3 * 10^5\ \text{m}$

$$F_G = mg\frac{1}{\left(1+\frac{h}{R_E}\right)^2}$$
$$= 4.55 * 10^5\ \text{kg} * 9.81\ \text{m/s}^2 \frac{1}{\left(1+\frac{3*10^5\ \text{m}}{6.37*10^6\ \text{m}}\right)}$$
$$F_G = \underline{\underline{4.03 * 10^6\ \text{kg m/s}^2}}$$

$$g(h) = \frac{g}{\left(1+\frac{h}{R_E}\right)^2}$$
$$g(3.3 * 10^5) = \underline{\underline{8.87\ \text{m/s}^2}}$$

$$v = r\omega; \quad a = \frac{v^2}{r} = r\omega^2; \quad r = R_E + h$$

c)

$$\omega = \sqrt{\frac{g(h)}{r}} = \underline{\underline{1.2 * 10^{-3}\ \text{s}^{-1}}}$$

d)

$$T = \frac{2\pi}{\omega} = \underline{\underline{5461.58\ \text{s}}}$$

e)

$$v = r\omega = \underline{\underline{7707.91\ \text{m/s}}}$$

# 152. Komprimierter Metallblock

$a = h = 0.2\ \text{m}$ $\quad \Delta h = 1.3 * 10^{-6}\ \text{m}$ $\quad m = 500\ \text{kg}$

$V = 8 * 10^{-3}\ \text{m}^3$ $\quad \Delta V = 3 * 10^{-7}\ \text{m}^3$ $\quad p = 2 * 10^6\ \text{kg/m s}^2$

a) $p = K\,\frac{\Delta V}{V}; \quad \frac{F}{A} = E\,\frac{\Delta h}{a}$

$$K = p\,\frac{V}{\Delta V} = \underline{\underline{\frac{16}{3} * 10^{10}\ \text{kg/m s}^2}}$$

$$E = \frac{mga}{a^2 \Delta h} = \underline{\underline{1.89 * 10^{10}\ \text{kg/m s}^2}}$$

b) $\Delta a = \mu \Delta h; \quad K = \frac{E}{3(1-2\mu)}$

$$K = \frac{E}{3(1-2\mu)}$$
$$\frac{3K}{E} = \frac{1}{1-2\mu}$$
$$\mu = \frac{1}{2} - \frac{E}{6K} = \underline{\underline{0.44}}$$

$$\Delta a = \mu \Delta h = \underline{\underline{5.73 * 10^{-7}\ \text{m}}}$$