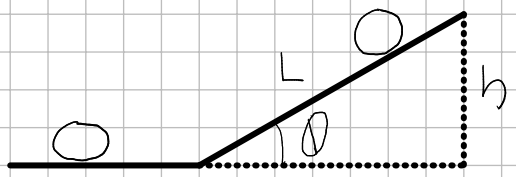
IFYTT1001, Nicolai H. Brand, 2022

Øving 5

① $r = 0{,}015\,m \quad m = 2{,}80\,kg$

$L = 1{,}20\,m \quad \theta = 35{,}0°$



$h = L \cdot \sin\theta$

a) Energi er bevart

$E_0 = E_1$

$mgL\sin\theta = \frac{1}{2}mv^2$

$v = \sqrt{2Lsin\theta g} = \sqrt{2 \cdot 1{,}20m \cdot \sin 35{,}0° \cdot 9{,}81\,m/s^2}$

$\underline{\underline{v = 3{,}67\,m/s}}$

b) $a = 4{,}02\,m/s^2$

1) $v^2 = 2aL$

$v = \sqrt{2aL} = \sqrt{2 \cdot 4{,}02\,m/s^2 \cdot 1{,}20m} = \underline{\underline{3{,}11\,m/s}}$

$\omega = \frac{v}{r} = \frac{3{,}11\,m/s}{0{,}015\,m} = \underline{\underline{207\,rad/s}}$

2) $E_{tot} = mgL\sin\theta = 2{,}80kg \cdot 9{,}81\,m/s^2 \cdot 1{,}20\,m \cdot \sin 35°$

$= \underline{\underline{18{,}9\,J}}$

Energi i bunn: $\frac{1}{2}mv^2 + \frac{1}{2}I\omega^2$

$$I = \frac{2}{5} m r^2$$

$$E_{tot} = \frac{1}{2} m \left(v^2 + \frac{2}{5} r^2 \omega^2 \right)$$

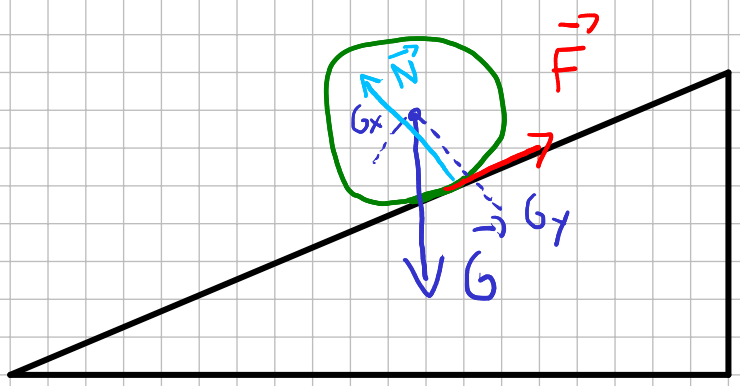
$$= \frac{1}{2} \cdot 2{,}80\,kg \left[(3{,}11\,m/s)^2 + \frac{2}{5} (0{,}015\,m \cdot 207\,rad/s)^2 \right]$$

$$= 18{,}9\,J$$

I det mer realistiske tilfelle blir noe av den potensielle energien omgjort til rotasjonsenergi.
Den totale energien er den samme i begge tilfellene.

c)

$|G_x| > |\vec{F}|$



$\vec{F} = \mu N$ $\quad G_x = mg\sin\theta$

$N = G_y$ $\quad G_y = mg\cos\theta$

1. $\sum F = ma$

$G_x - \vec{F} = ma$

2. $\sum \tau = I\alpha$

$\vec{F} \times \vec{r} = I\alpha$

$\vec{F} \times \vec{r} = I \frac{a}{r}$

$\frac{\vec{F} r^2}{I} = a$

$G_x - \vec{F} = m \frac{\vec{F} r^2}{I}$

$G_x = \vec{F}\left(1 + \frac{mr^2}{I}\right)$

$\vec{F} = \frac{mg\sin\theta}{1 + \frac{mr^2}{\frac{2}{5}mr^2}} = \frac{2mg\sin\theta}{7}$

$\vec{F} = \frac{2 \cdot 2{,}80\,kg \cdot \sin 35^\circ}{7} = 0{,}459\,N$

d)

Topp:

$E_0 = mgh_A$

Bunn:

$E_1 = \frac{1}{2}mv_0^2 + \frac{1}{2}I\omega^2$

Loop

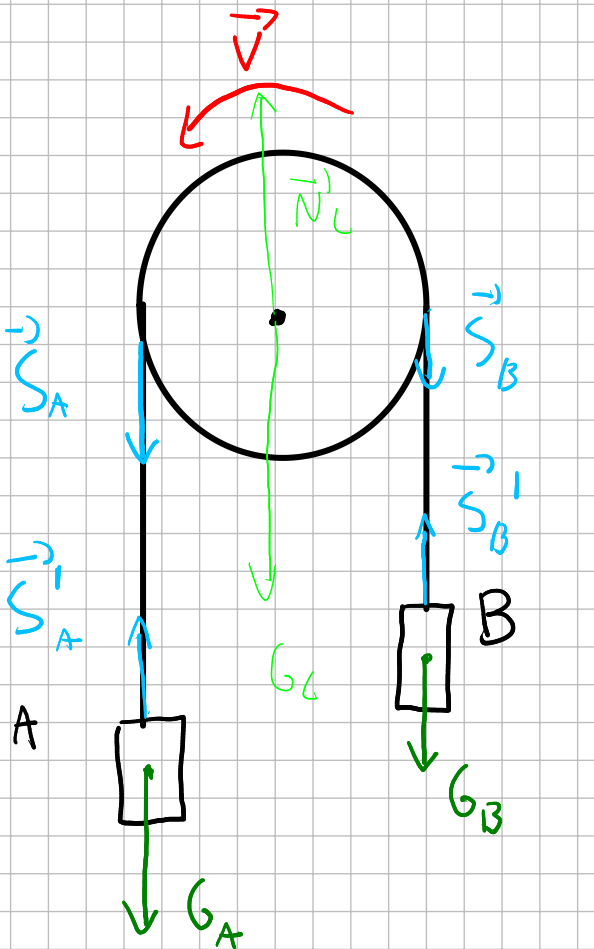
$E_L = mgh_B + \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2$

$mgh_A = mgh_B + \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2$

(2) $m_A = 35{,}0\,kg$ $m_B = 21{,}0\,kg$ $m_L = 25{,}0\,kg$

$r = 0{,}150\,m$

a)



b) $\sum \tau = I\alpha$

$r(\vec{S}_A - \vec{S}_B) = I\alpha$

$\vec{S}_A - \vec{S}_B = \frac{I\alpha}{r}$

Lodd A:

$\sum F = m_A a$

$\vec{G}_A - \vec{S}_A = m_A a$

$$\vec{S_A} = -M_A a + M_A g$$

Lodd B:

$$\sum F = M_B a$$
$$S_B - G_B = M_B a$$
$$\vec{S_B} = M_B a + M_B g$$

$$M_A g - M_A a - M_B a - M_B g = \frac{I\alpha}{r}, \quad \alpha = \frac{a}{r}$$

$$M_A g - M_A a - M_B a - M_B g = \frac{Ia}{r^2}$$

$$a\left(\frac{I}{r^2} + M_A + M_B\right) = g(M_A - M_B)$$

$$a = \frac{g(M_A - M_B)}{M_A + M_B + \frac{I}{r^2}} = \frac{g(M_A - M_B)}{M_A + M_B + \frac{1}{2}M_L} = 2{,}40\ m/s^2$$

c)

$$\vec{S_A} = M_A(-a + g) = 273N$$
$$\vec{S_B} = M_B(a + g) = 248N$$

d) Siden det er et dreiemoment rundt vi

$S_A - S_B = I\alpha$. Når $\alpha \neq 0$ blir $S_A \neq S_B$

(3)

$m = 2{,}00\,kg$

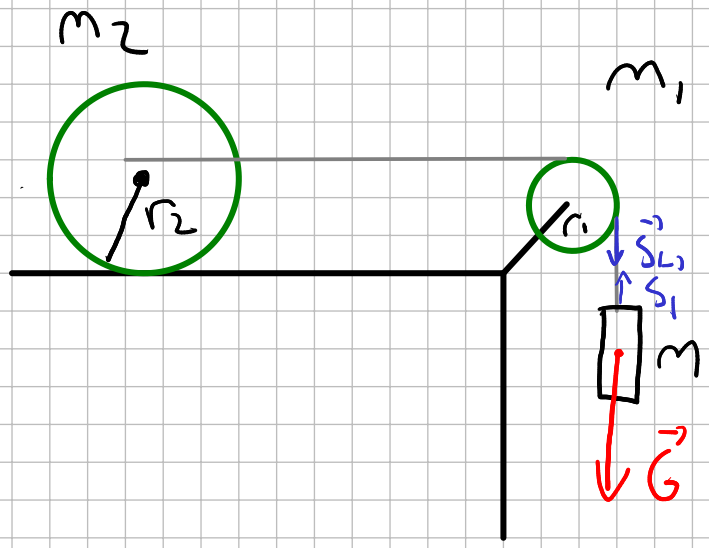
$m_1 = 1{,}10\,kg$

$r_1 = 0{,}1\,m$

$m_2 = 5{,}00\,kg$

$r_2 = 0{,}2\,m$

$a_{Wdc} = 1{,}80\,m/s^2$



a)

$$\vec{G} = mg = 2{,}00\,kg \cdot 9{,}81\,m/s^2 = \underline{19{,}6\,N}$$

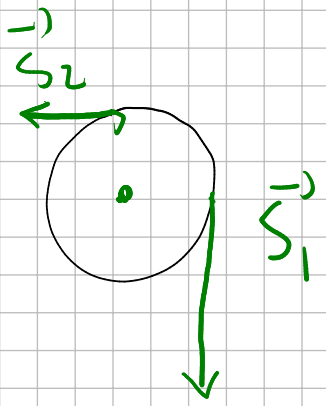
$$\sum F = ma$$

$$\vec{G} - \vec{S}_1 = ma$$

$$\vec{S}_1 = mg - ma = m(g-a)$$

$$= 2{,}00\,kg\,(9{,}81\,m/s^2 - 1{,}80\,m/s^2) = \underline{16{,}0\,N}$$

b)



$$\sum \tau = I\alpha$$

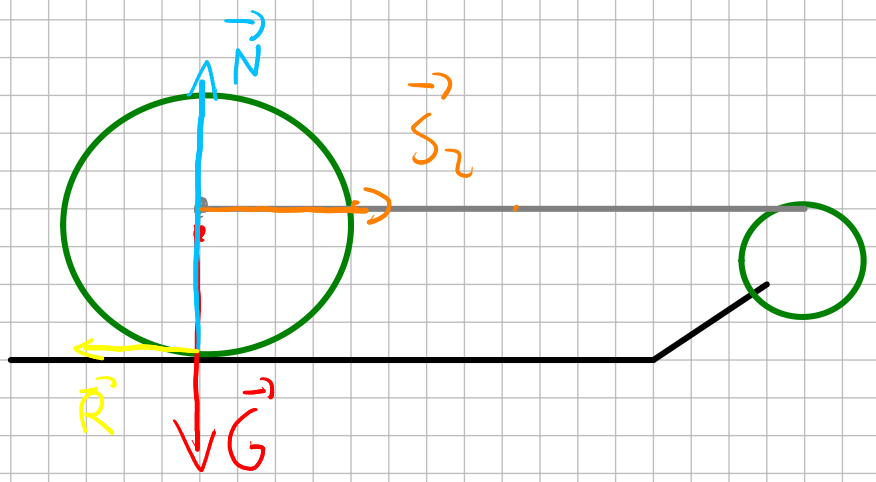
$$\vec{S}_1 r - \vec{S}_2 r = \frac{1}{2} m_1 r^2 \alpha$$

$$\vec{S}_2 = \vec{S}_1 - \frac{1}{2} m_1 a$$

$$= 16{,}0\,N - \frac{1}{2} \cdot 1{,}10\,kg \cdot 1{,}80\,m/s^2$$

$$= \underline{15{,}0\,N}$$

c)



Ser på trinna:

$$\vec{R}r = I\alpha$$

$$I = \frac{\vec{R}r^2}{a}$$

$$I = \frac{(\vec{S}_2 - m_2 a)\, r^2}{a}$$

$$= \frac{(15N - 5{,}00kg \cdot 1{,}80 m/s^2) \cdot (0{,}12m)^2}{1{,}80\, m/s^2}$$

$$= \frac{2}{15}\, kgm^2 = 134\, kgm^2$$

$$\sum F_x = m_2 a$$

$$\vec{S}_2 - \vec{R} = m_2 a$$

$$\vec{R} = \vec{S}_2 - m_2 a$$

(4) Fart er null i topp og bunnpunkt.

$E_0 = E_1$

V.S $E_0 = mg(l+x)$

H.S $E_1 = \frac{1}{2}kx^2$

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