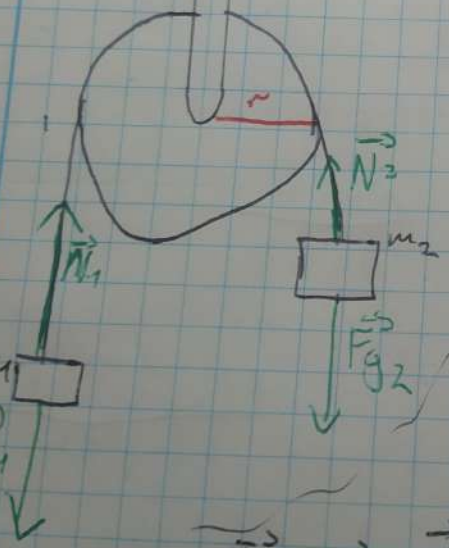
Zadanie 4.8 ;

4.8

$r = 10\,cm = 0{,}1\,m$
$m_0 = 0{,}4\,kg$
$m_1 = 0{,}2\,kg$
$m_2 = 0{,}4\,kg$
$g = 10\,\frac{m}{s^2}$

a)



F_{g_1} ; F_{g_2} to siły ciężkości

$\vec{N_1}$; $\vec{N_2}$ to siły naciągu linki

b) Ponieważ:

$m_2 > m_1$ to $F_{g_2} > F_{g_1}$

z tego wynika:

$N_2 > N_1$

$M_1 < M_2$

z reguły prawo śruby mówi:

M_1 ⊙ - przed kartkę

M_2 ⊗ - za kartkę

Wypadkowy moment siły: prostopadły do kartki i zwrot za kartkę ⊗

$\vec{M} = \vec{r} \times \vec{F}$

$\vec{M_1} = \vec{r} \cdot \vec{N_1}$

1 krok

c)

$\vec{M_2} = \vec{r} \times \vec{N_2}$

$M_2 = r \cdot N_2 \cdot \sin 90°$

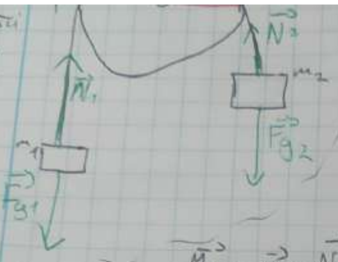
2 krok

$M_1 = r \cdot N_1 \cdot \sin 90° \Rightarrow M_1 = r \cdot N_1$

3 krok

ciężkości

$\vec{N_1}$ i $\vec{N_2}$ to siły naciągu linki



c)

Wyrażamy moment siły: prostopadły do kartki i zwrot za kartkę

1 krok

$\vec{M} = \vec{r} \times \vec{F}$

$\vec{M_1} = \vec{r} \cdot \vec{N_1}$

$M_1 = r \cdot N_1 \cdot \sin 90^\circ \Rightarrow M_1 = r \cdot N_1$

2 krok

$\vec{M_2} = \vec{r} \times \vec{N_2}$

$M_2 = r \cdot N_2 \cdot \sin 90^\circ$

$M_2 = r \cdot N_2$

$M_w = M_2 - M_1$

$M = J \cdot \varepsilon$

3 krok

$M_2 - M_1 = J \cdot \varepsilon$

$J = \frac{1}{2} m r^2$ $\qquad \varepsilon = \frac{a}{r}$

$M_2 - M_1 = J \cdot \varepsilon$

$N_2 \cdot r - N_1 \cdot r = \frac{1}{2} m_b r^2 \cdot \frac{a}{r}$

$(N_2 - N_1) \cdot r = \frac{1}{2} m_b r a$

$N_2 - N_1 = \frac{1}{2} m_b a$

4 krok

$$\begin{cases} m_1 a = N_1 - F_{g1} \\ m_2 a = F_{g2} - N_2 \end{cases}$$

$F_g = mg$

$$\begin{cases} m_1 a = N_1 - m_1 g \\ m_2 a = m_2 g - N_2 \end{cases}$$

podstawiamy

$$+\begin{cases} m_1 a = N_1 - m_1 g \\ m_2 a = m_2 g - N_2 \end{cases}$$

$m_1 a + m_2 a = N_1 - m_1 g + m_2 g - N_2$

$m_1 a + m_2 a = N_1 - m_1 g + m_2 g - N_2$

$m_1 a + m_2 a = -N_2 + N_1 + m_2 g - m_1 g$

$m_1 a + m_2 a = -(N_2 - N_1) + m_2 g - m_1 g$

$m_1 a + m_2 a = -\frac{1}{2} m_b a + m_2 g - m_1 g \quad | + \frac{1}{2} m_b a$

$m_1 a + m_2 a + \frac{1}{2} m_b a = m_2 g - m_1 g$

$(m_1 + m_2 + \frac{1}{2} m_b) a = (m_2 - m_1) g$

$$a = \frac{m_2 - m_1}{m_1 + m_2 + \frac{1}{2} m_b} \cdot g$$

Podstawiamy

$$a = \frac{0{,}4\,kg - 0{,}2\,kg}{0{,}2\,kg + 0{,}4\,kg + \frac{1}{2}\cdot 0{,}1\,kg}\cdot 10\,\frac{m}{s^2} = \frac{0{,}2\,kg}{0{,}8\,kg}\cdot 10\,\frac{m}{s^2}$$

$$= 0{,}25 \cdot 10\,\frac{m}{s^2} = 2{,}5\,\frac{m}{s^2}$$

$$\varepsilon = \frac{a}{r} \qquad \varepsilon = \frac{2{,}5\,\frac{m}{s^2}}{0{,}1\,m} = 25\,\frac{rad}{s^2}$$

d) 2 podpunkt c) wiemy:

$$\begin{cases} m_1 a = N_1 - F_{g1} & /+F_{g1} \\ m_2 a = F_{g2} - N_2 & /+N_2 \end{cases}$$

$$\begin{cases} m_1 a + F_{g2} = N_1 \\ m_2 a + N_2 = F_{g2} & /-m_2 a \end{cases}$$

$$\begin{cases} N_1 = m_1 a + m_1 g \\ N_2 = m_2 g - m_2 a \end{cases}$$

$$\begin{cases} N_1 = m_1 (a+g) \\ N_2 = m_2 (g-a) \end{cases}$$

Podstawiamy

$$\begin{cases} N_1 = 0{,}2\,kg \cdot \left(2{,}5\,\frac{m}{s^2} + 10\,\frac{m}{s^2}\right) \\ N_2 = 0{,}4\,kg \cdot \left(10\,\frac{m}{s^2} - 2{,}5\,\frac{m}{s^2}\right) \end{cases}$$

$$\begin{cases} N_1 = 0{,}2\,kg \cdot 12{,}5\,\frac{m}{s^2} \\ N_2 = 0{,}4\,kg \cdot 7{,}5\,\frac{m}{s^2} \end{cases}$$

$$\begin{cases} N_1 = 2{,}5\,N \\ N_2 = 3\,N \end{cases}$$