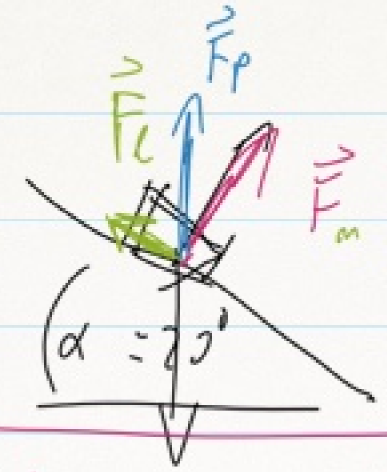
1.)



$F_p = F_g$ če miruje } (5)

→ Razmevanje √(5)

$F_t = F_p \sin\alpha = 3{,}76\ N$

$g = 10\ m/s^2$

(9,3 N)

Če simbolno vse prav, odbitek:
- 5 točk, če 1-2 številski narobe
- 10 točk, če 3-4 številske narobe

$F_n = F_p \cos\alpha = 9{,}22\ N$ √(5)

3,3 N

Max: $F_d = F_t \Rightarrow k_e mg \cos\beta = mg \sin\beta$

$\beta = 30°$ √(5)

$F_{60} = F_d - F_t = mg \sin 60 - mg\, k_e \cos 60$

$\Rightarrow a = g\left(\frac{\sqrt{3}}{2} - \frac{\sqrt{3}}{3}\frac{1}{2}\right) = \frac{10}{\sqrt{3}} = 5{,}66\ m/s^2$ √(5)

(5,77)

4.)

a)

Odbitek 5 točk, če simbolno prav in 1-2 številski narobe

$M = k x \cdot d - \left(m_p g \frac{l}{2} - m_k g l\right)\sin\varphi$ √(5)

$x = d \sin\varphi = d\varphi \Rightarrow M = \left(kd^2 - gl\left(\frac{m_p}{2} + m_k\right)\right)\varphi = 49\ Nm\ \varphi$

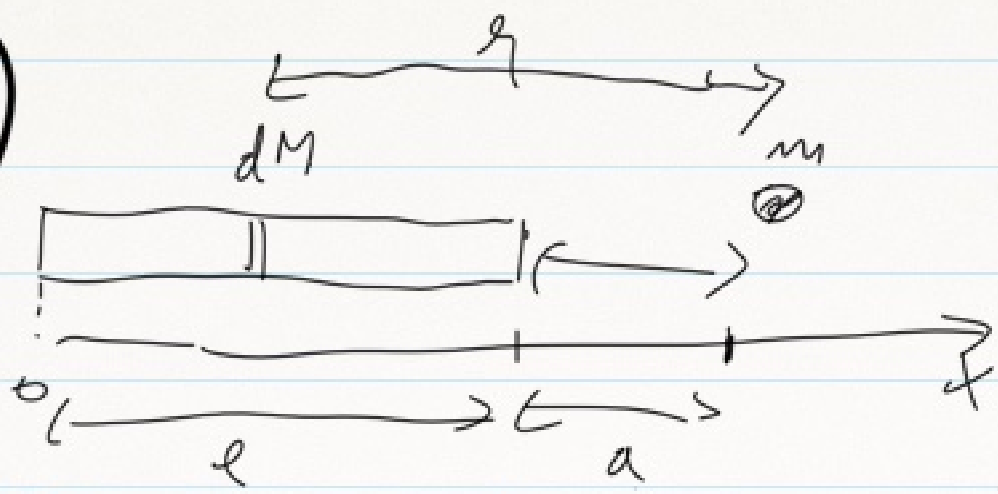
$J = \frac{m_p l^2}{3} + m_k l^2$ √(5) $\Rightarrow \omega = \sqrt{\frac{kd^2 - gl\left(m_k + \frac{m_p}{2}\right)}{\frac{m_p l^2}{3} + m_k l^2}} \Rightarrow \omega = 6{,}06\ Hz \Rightarrow \nu = \frac{\omega}{2\pi} = 0{,}96\ Hz$ √(5)

Razmevanje: povezava odmika $\varphi_0 \Leftrightarrow$ hitrost ω_0

b) $\varphi = \varphi_0 \sin\omega t \Rightarrow \frac{d\varphi}{dt} = \varphi_0 \omega \cos\omega t$ √(5) $\Rightarrow \varphi_0 = \frac{\omega_0}{\omega} = \frac{0{,}5}{6{,}06} = 0{,}082$

$\Rightarrow \varphi = \frac{\omega}{\omega_0} \sin\omega_0 t \Rightarrow \varphi(t = 1s) = -0{,}018$ √(5)

5.)



(Odbitek 5 točk, če ne pravi, ni 1-2 številki narobe)

$dr = -dx$ Razmerje (5)

Varianta A: Račun preko sil

$$dF = \frac{dM\, m\, G}{r^2} \qquad r = l + a - x, \quad dM = \frac{dx}{l}\cdot M$$

$$F = \frac{GMm}{l}\int_0^l \frac{dx}{(l+a-x)^2} = -\frac{GMm}{l}\int_{l+a}^{a}\frac{dr}{r^2} = +\frac{GMm}{l}\,\frac{1}{r}\Big|_{l+a}^{a} = \frac{GMm}{l}\left(\frac{1}{a} - \frac{1}{l+a}\right)$$

√(5) postopek

$$A = -\int_a^\infty F\,dx = -\int_a^\infty \frac{GMm}{l}\left(\frac{1}{x} - \frac{1}{l+x}\right) = \frac{GMm}{l}\ln a - \ln(l+a)$$

√(5) postopek $\Rightarrow v^2$ (glej spodaj)

Varianta B: Račun preko potenciala

$$dU = -\frac{dM\, m\, G}{r} \Rightarrow U = -\frac{GMm}{l}\int_0^l \frac{dx}{l+a-x} = +\frac{GMm}{l}\int_{l+a}^{a}\frac{dr}{r}$$

√ postopek (5)

√(5) Razmerje

$$U(a) = \frac{GMm}{l}\left(\ln(a) - \ln(l+a)\right) = \frac{GMm}{l}\ln\frac{a}{a+l}$$

Ubežna hitrost: $U(\infty) - U(a) = A = 3{,}5\ \mathrm{mJ}$ √(5) (5)

$$F = \frac{6{,}67\cdot 10^{-11}\cdot 3\cdot 10^{6}\cdot 720\ \mathrm{kg\,m^3/s^2}}{100\ \mathrm{m}}\left(\frac{1}{10\,\mathrm{m}} - \frac{1}{110\,\mathrm{m}}\right) = 0{,}13\ \mathrm{mN}$$ √(5) (5)

Sila: $F = -\frac{dU}{da} = +\frac{GMm}{l}\frac{1}{a} - \frac{GMm}{l}\frac{1}{l+a}$ √(5) (isto kot preko sil)

Varianta C: (Napačen račun) $F = \frac{mMG}{60\,\mathrm{m}^2} = 4\cdot 10^{-5}\ \mathrm{N}$ (5) $A = \frac{mMG}{60\,\mathrm{m}} = 2{,}4\ \mathrm{mJ}$ (5)