Oblig 3 Fys-Mek 1110 Vår -21

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a) What is the given position $s(t)$ by $l_0 = 0.5m$?

$s(t) = x(t)$

By $t = 0$, $l_0 = 0.5m$ and $h = 0.3m$

Pyt. → $0.5m = \sqrt{(0.3m)^2 + (x(0))^2}$

x_0

$\sqrt{(0.5m)^2 - (0.3m)^2} = x_0$

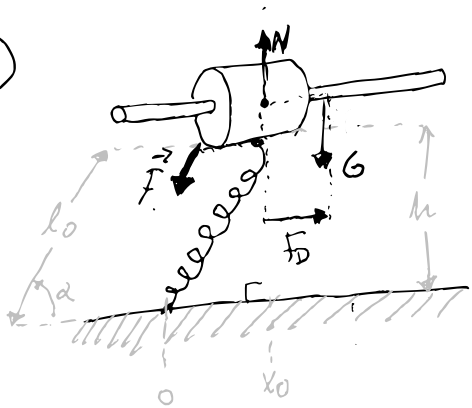
$\underline{\underline{x_0 = 0.4m}}$

b) The block will only move alongside the x-xis; this means that the spring will never be shorter than the height between the block and the attachment point.

→ $l = \sqrt{(0.3m)^2 + (s(t))^2}$

$= \sqrt{(0.3m)^2 + (x(t))^2}$

c)



Normal

$N = G$ - gravitation

$\vec{F} = \vec{F}_D$

Spring Friction

d) Springforce $F = -k(r - L_0)\frac{r}{r}$

In x-direction: $F_x = -k(r - L_0)\frac{x}{r}$

$= -k\left(\frac{rx}{r} - \frac{L_0 x}{r}\right)$

$= -k\left(x - \frac{L_0 x}{r}\right)$

$= -kx\left(1 - \frac{L_0}{r}\right)$

Insert: $r = \sqrt{x^2 + y^2}$

given: $h = y$

$\Rightarrow F_x = -kx\left(1 - \frac{L_0}{\sqrt{x^2 + h^2}}\right)$ ■

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Task e, f and g further down ↓

...

h) Force in y-direction. ! Again: $h = y$

$F_y = -k(r - L_0)\frac{h}{r}$

$= -k\left(\frac{rh}{r} - \frac{L_0}{r}\right)$ Insert $r = \sqrt{x^2 + y^2}$

$= -k\left(h - \frac{L_0}{r}\right)$

$= -kh\left(1 - \frac{L_0}{r}\right)$

$\Rightarrow F_y = -kh\left(1 - \frac{L_0}{\sqrt{x^2 + h^2}}\right)$ ■

i) Siden at sylinderen står i ro, må N (normalkraft) være lik samme som G (gravitasjons kraften):

$\Rightarrow N = G = mg = 5kg \cdot 9.81 m/s^2 = \underline{49.05\ N (newton)}$

j) Hvis summen av kreftene på sylinderen er null (står stille), vil:

$\Sigma F = 0$

$\Rightarrow N + (-G) + (-k\,h\,(1 - \frac{L_0}{\sqrt{x^2+h^2}})) = 0$

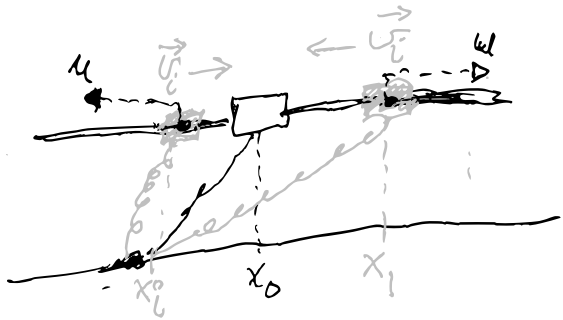
(kraft i x-retning (bevegelsesretning))

$\Rightarrow N(x) - mg = k\,h\,(1 - \frac{L_0}{\sqrt{x^2+h^2}})$

$N(x) = k\,h\,(1 - \frac{L_0}{\sqrt{x^2+h^2}}) + mg$

N ved $x_0 = 0.4$ peker oppover med like stor kraft som G.

k)



$u = N \cdot \mu_d$ where $N = |N|$ and $\mu_d = 0.05$