L1 (Redw. planke).

a) $v_x = v_0 e^{-\frac{b}{m}t}$

For å finne kraften, trengs akselerasjonen

$$a_x = \frac{dv_x}{dt} = -\frac{b}{m} v_0 e^{-\frac{b}{m}t} = -\frac{b}{m} v_x$$

$$F_x = m a_x = -b v_0 e^{-\frac{b}{m}t} = \underline{\underline{-b v_x}}$$

b: mål for f. eks. friksjon i væske.

b) $$x = \int v_x \, dt = v_0 \int e^{-\frac{b}{m}t} dt$$

$$= -\frac{m}{b} v_0 e^{-\frac{b}{m}t} + K.$$

Beg. bet. gir K:

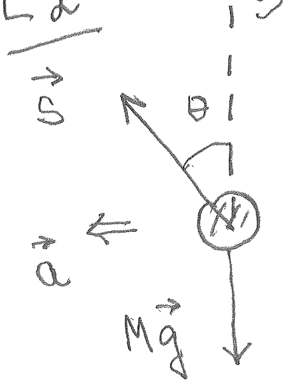
$$0 = x(0) = -\frac{m v_0}{b} + K \Rightarrow$$

$$\underline{\underline{x(t) = \frac{m v_0}{b}\left[1 - e^{-\frac{b}{m}t}\right]}}$$

Inntrengning til

$$L = x(t = \infty) = \underline{\underline{\frac{m v_0}{b}}}$$

a) Fri-legeme diagram for M:



Horisontal bevegelse:

$$S \sin\theta = Ma = Mv^2/R$$
$$= M\omega^2 R = M\omega^2 L \sin\theta \quad (1a)$$

For $\theta \neq 0$ gir ~~dette~~:

$$\underline{S = ML\omega^2} \quad (1b)$$

Vertikal likevekt:

$$S \cos\theta = Mg \qquad \cos\theta = \frac{Mg}{S} \quad (2a)$$

Komb. med (1b) $\Rightarrow$ $\underline{\cos\theta = \frac{g}{\omega^2 L}}$ (2b)

b) $\omega \to \infty \Rightarrow \cos\theta \to 0 \qquad \underline{\theta \to \pi/2}$

(Prøv med kule i snor).

ω avtar $\Rightarrow$ $\cos\theta$ øker.

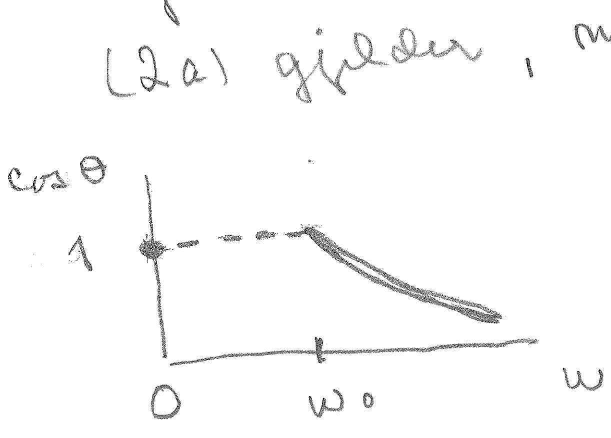
Minste ω når $\cos\theta \to 1$. $\underline{\omega_0^2 = \frac{g}{L}}$

c) $\omega = 0$ Løsning med $\theta = 0$, $S = mg$

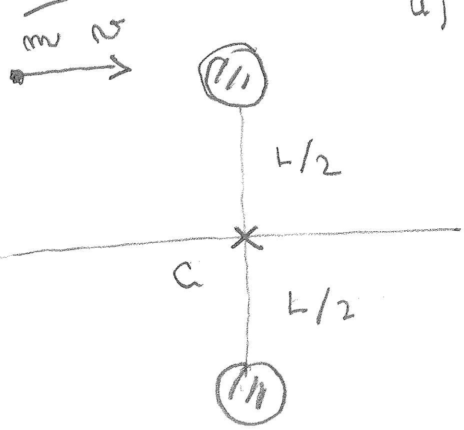
Inneholdes ikke i løsn. fra a)

fordi (1b) forutsetter $\theta \neq 0$.

(2a) gjelder, men ikke (1b) og (2b).



L3



a) Antar innkommende part. har fart v.

Bevarelse av bev. mengde

$$mv = (2M+m)V \approx 2MV \quad (1)$$

Bevarelse av spinn

$$mv\frac{L}{2} = I_0\omega \approx 2M\left(\frac{L}{2}\right)^2\omega$$

$$mv = ML\omega \quad (2)$$

$m << M$

Masse-senteret omtrent i C.

$$(1)=(2) \Rightarrow 2MV = ML\omega \qquad \underline{\underline{V/\omega = L/2}}$$

b)
$$E_{tr} \approx \frac{1}{2}(2M)V^2 = MV^2$$

$$E_{rot} \approx \frac{1}{2}I\omega^2 = \frac{1}{2}(2M)\left(\frac{L}{2}\right)^2\omega^2 = \frac{1}{4}ML^2\omega^2$$

$$E_{tr}/E_{rot} = \frac{MV^3}{\frac{1}{4}ML^2\omega^2} = \frac{4V^2}{L^2\omega^2} = \left(\frac{2V}{L\omega}\right)^2 = \underline{\underline{1}}$$

c)
$$E_{etter} = E_{tr} + E_{rot} = 2E_{tr} = 2\cdot\frac{1}{2}(2M)V^2$$

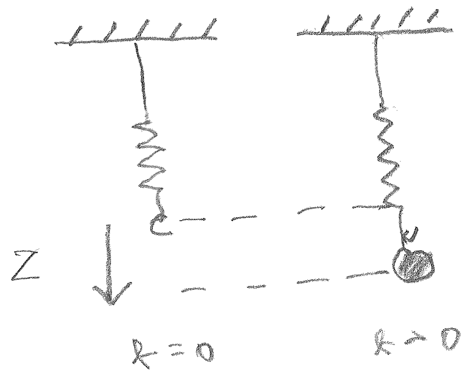
$$= 2MV^2 = 2M\left(\frac{mv}{2M}\right)^2$$

$$= \left(\frac{1}{2}mv^2\right)\frac{m}{M} = \underline{\underline{\frac{m}{M}E_{før} << E_{før}}}$$

Nesten all kin. energi tapes.

Ex: Elektron-H_2 $\Rightarrow$ $m/M \approx 1/4000$

a)



$$m \frac{d^2 z}{dt^2} = -kz + mg$$

(Velger pos. z nedover)

$$\frac{d^2 z}{dt^2} + \frac{k}{m} z = g \,, \quad \frac{k}{m} \equiv \omega_0^2$$

Homogen-løsn: $z_H = A\sin\omega_0 t + B\cos\omega_0 t$

Partik. int. $z_p = \frac{mg}{k}$

Alm. løsn $z = A\sin\omega_0 t + B\cos\omega_0 t + \frac{mg}{k}$

Randbet: $0 = z(0) \Rightarrow 0 = B + \frac{mg}{k} \quad B = -\frac{mg}{k}$

$$0 = \frac{dz}{dt}\Big|_0 = \omega_0 A \Rightarrow A = 0$$

$$z(t) = \frac{mg}{k}\left[1 - \cos\omega_0 t\right] \quad \xrightarrow{max} \frac{2mg}{k} \,, \quad \xrightarrow{min} 0$$

Svinger mellom 0 og $\frac{2mg}{k}$.

b) Liten dempning vil endre homo. løsn med faktor $e^{-\delta t}$ (og senke ω noe).

$$z(t) = \frac{mg}{k}\left[1 - e^{-\delta t}\cos\omega_0 t\right] \xrightarrow{t\to\infty} \frac{mg}{k}$$

Likevekt ved $kz = mg$: fjærkraft = tyngdekraft.