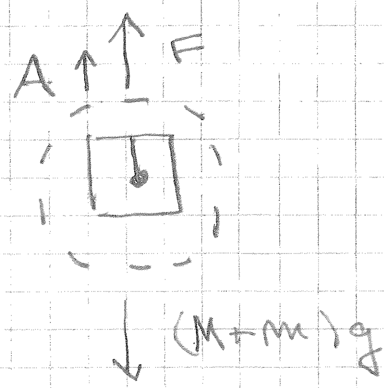
L1

a) Kasse + masse:

$$F-(M+m)g=(M+m)A$$

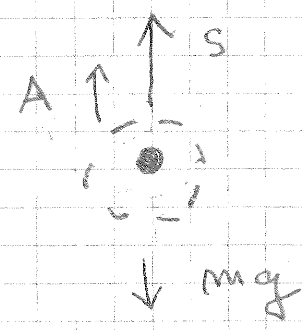
$$\underline{A=\frac{F}{M+m}-g}$$



b) Masse:

$$S-mg=mA$$

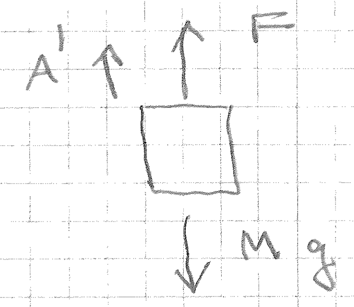
$$S=m(A+g)=\underline{\frac{m}{M+m}F}.$$



c) Kasse:

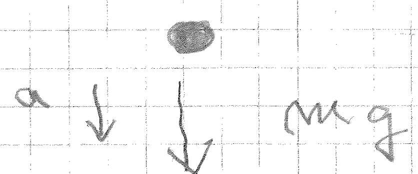
$$F-Mg=MA'$$

$$\underline{A'=\frac{F}{M}-g}$$



Masse

$$\underline{a_m=g}.$$



d) Relativ akselerasjon kasse-masse

$$A_{rel}=A'+g=\frac{F}{M}.$$

$$V=A_{rel}t \qquad h=\tfrac{1}{2}A_{rel}t^2 \Rightarrow$$

$$t=\sqrt{\frac{2h}{A_{rel}}}=\underline{\sqrt{\frac{2hM}{F}}} \qquad V=\frac{F}{M}\sqrt{\frac{2hM}{F}}=\underline{\sqrt{\frac{2hF}{M}}}$$

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

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

L3

a) Sand på skive: $m(t) = \mu t$

Spinn av skive pluss sand.

$$L(t) = (I_0 + I_s)\,\omega = \left(\tfrac{1}{2}MR^2 + m r^2\right)\omega$$

$$L(t) = L(t=0) \Rightarrow$$

$$\left(\tfrac{1}{2}MR^2 + m r^2\right)\omega = \tfrac{1}{2}MR^2\,\omega_0$$

$$\underline{\omega(t) = \frac{I_0}{I_0 + \mu r^2 t}\,\omega_0}$$

b) $$E = \tfrac{1}{2} I \omega^2 = \tfrac{1}{2} I \left(\frac{I_0}{I}\right)^2 \omega_0^2$$

$$= \frac{1}{2}\frac{I_0^2}{I}\omega_0^2 = \frac{I_0}{I} E_0$$

$$\underline{E(t) = \frac{I_0}{I_0 + \mu r^2 t}\,E_0}$$

$$E(t') = E_0/2 \Rightarrow \mu r^2 t' = I_0$$

$$\underline{t' = \frac{I_0}{\mu r^2}}$$

L4 Øving 3 Løsning

a)

$$x = A\cos\left(\sqrt{\frac{k}{m}}\,t\right) \Rightarrow v_x = \frac{dx}{dt} = -A\sqrt{\frac{k}{m}}\sin\left(\sqrt{\frac{k}{m}}\,t\right)$$

$$K = \frac{1}{2} m v_x^2 = \frac{1}{2} k A^2 \sin^2\left(\sqrt{\frac{k}{m}}\,t\right)$$

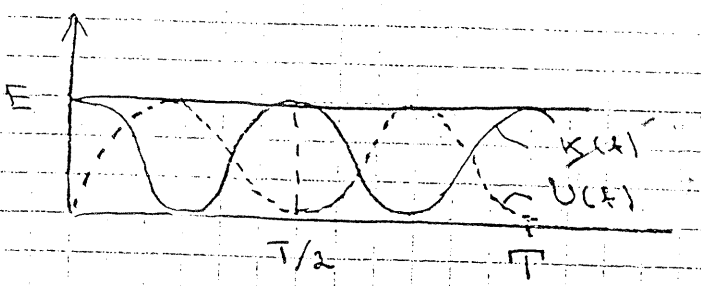
$$U = \frac{1}{2} k x^2 = \frac{1}{2} k A^2 \cos^2\left(\sqrt{\frac{k}{m}}\,t\right)$$

Mrk: Både K og U varierer med tiden. Når den ene er stor er den andre liten.

Totale energi

$$E = K + U = \frac{1}{2} k A^2 \left[\sin^2\left(\sqrt{\frac{k}{m}}\,t\right) + \cos^2\left(\sqrt{\frac{k}{m}}\,t\right)\right] = \underline{\frac{1}{2} k A^2}$$

Periode $T = 2\pi\sqrt{\frac{m}{k}}$



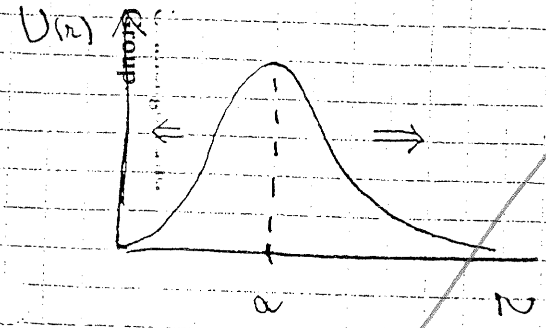
b)

$$F_r = -\frac{dU}{dr} = \frac{k}{2}\left[2r e^{-r/a} - r^2 \frac{2}{a} e^{-r/a}\right]$$

$$\underline{F_r = -kr\left[1 - \frac{r}{a}\right] e^{-2r/a}}$$

$0 < r < a$ $\quad F_r < 0 \Rightarrow$ tiltrekkende

$r > a$ $\quad F_r > 0 \Rightarrow$ frastøtende,



Likevektspkt. for $F_r = 0$

dvs. i $r = 0$ og i $r = a$.

Liten forskyvning fra $r = 0$ gir kraft inn mot $r = 0$ :: likevekten søkes gjenopprettet (stabilitet).

Forskyvn. fra $r = a$ gir kraft bort fra $r = a$ (usta-