Eksamen haust 2013

Løysingsforslag

Oppg. 1

a) - Konstant deselerasjon a i $s = 2.00\,m$.
- Har då farten $v_{max} = 8.00\,m/s$
- Ingen startfart

$s = \frac{1}{2} a t^2$ der t er tida.

Også: $v_{max} = a t \Leftrightarrow t = \frac{v_{max}}{a}$

$$s = \frac{1}{2} a \left(\frac{v_{max}}{a}\right)^2 = \frac{v_{max}^2}{2a}$$

$$a = \frac{v_{max}^2}{2s} = \frac{(8.00\,m/s)^2}{2 \cdot 2.00\,m} = \underline{\underline{16.0\,m/s^2}}$$

Vi kunne også ha brukt formelen

$v^2 - v_0^2 = 2as$ (med $v_0 = 0$).

b) For bilen: $s_b = 10.0\,m$, $a_b = 10.0\,m/s^2$

$s_b = \frac{1}{2} a_b t_b^2$, der t_b er tida bilen brukar.

$$t_b = \sqrt{\frac{2s}{a}} = \sqrt{\frac{2 \cdot 10.0\,m}{10.0\,m/s^2}} = \underline{\underline{1.41\,s}}$$

c) Tid på dei fyrste 2.00m:

$$v_{max} = a\,t_1$$

$$t_1 = \frac{v_{max}}{a} = \frac{8.00\,m/s}{16.0\,m/s^2} = 0.500\,s$$

Tid på dei siste metrane:

$$s_2 = 10.0\,m - 2.00\,m = 8.00\,m$$

$$s_2 = v_{max}\,t_2$$

$$t_2 = \frac{s_2}{v_{max}} = \frac{8.00\,m}{8.00\,m/s} = 1.00\,s$$

Totalt:

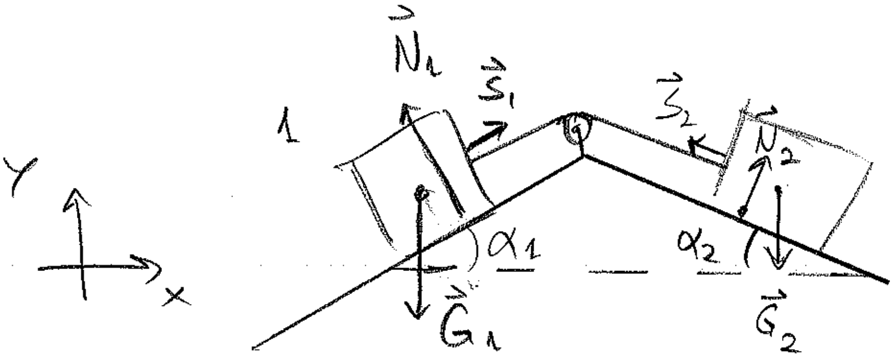
$$t = t_1 + t_2 = (0.500 + 1.00)\,s = \underline{\underline{1.50\,s}} > t_b$$

Oppg. 2

$m_1 = 10.0\,kg$

$m_2 = 3.00\,kg$

$\alpha_1 = 5.00^\circ$

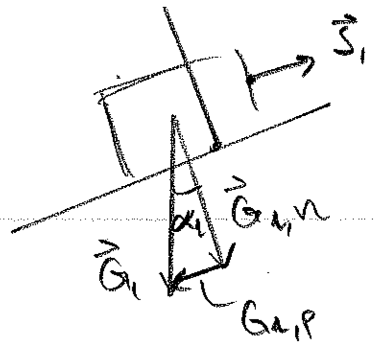


a) I ro: Summen av alle krefter er null, $\Sigma \vec{F} = \vec{0}$.

Snordraga $\vec{S}_1$ og $\vec{S}_2$ har ulike retningar, men er like store;

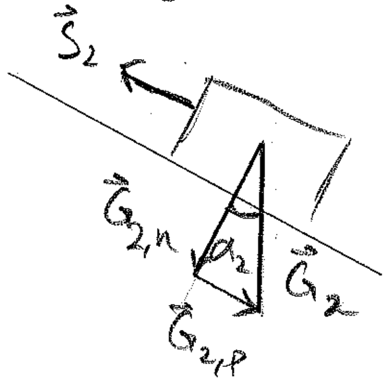
$S_1 = S_2 = S$.

For at klosse 1 skal vere i ro langs bordet:



$S = G_{1,p} = m_1 g \sin \alpha_1$, der $g = 9.81\,m/s^2$

For kloss 2:



$S = G_{2,p} = m_2 g \sin \alpha_2$

Vi får:

$m_1 g \sin \alpha_1 = m_2 g \sin \alpha_2$

$$\sin \alpha_2 = \frac{m_1}{m_2} \sin\alpha_1 = \frac{10.0}{3.00} \sin 5.00° = 0.2905$$

$$\alpha_2 = \arcsin 0.2905 = 16.8890° \approx \underline{\underline{16.9°}}$$

b) Har lov til å bare se på kreftene langs bordet. Newtons 2. lov gir då at

$$(m_1 + m_2)a = G_{2,p} - S + S - G_{1,p} = G_{2,p} - G_{1,p}$$

der a er akselerasjonen.

$$a = \frac{G_{2,p} - G_{1,p}}{m_1 + m_2} = \frac{g m_2 \sin\alpha_2 - g m_1 \sin\alpha_1}{m_1 + m_2} =$$

$$g \, \frac{m_2 \sin\alpha_2 - m_1 \sin\alpha_1}{m_1 + m_2} =$$

$$9.81\ \text{m/s}^2 \cdot \frac{(3.50 \cdot 0.2905 - 10.0 \cdot \sin 5.00°)\,\text{kg}}{(10.0 + 3.50)\,\text{kg}} =$$

$$0.10545\ \text{m/s}^2 \approx \underline{\underline{0.105\ \text{m/s}^2}}$$

Oppg. 3

a) Omløpstid: $T = 12.0\,s$

Radius i sirkelbane: $r = 7.50\,m$

Masse: $m = 75.0\,kg$

Fart: $v = \frac{2\pi r}{T} = \frac{2\pi \cdot 7.50\,m}{12.0\,s} = 3.9270\,m/s$

Kinetisk energi:

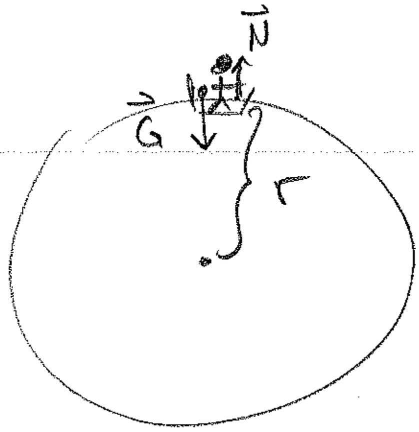
$E_k = \frac{1}{2} m v^2 = \frac{1}{2} \cdot 75.0\,kg \cdot (3.9270\,m/s)^2 =$

$578.30\,J \approx \underline{\underline{578\,J}}$

b) Sentripetal-akselerasjon:

$a_s = \frac{v^2}{r} = \frac{(3.9270\,m/s)^2}{7.50\,m} = 2.056\,m/s^2 \approx \underline{\underline{2.06\,m/s^2}}$

c)



Sentripetalkraft: $F_s = m a_s$

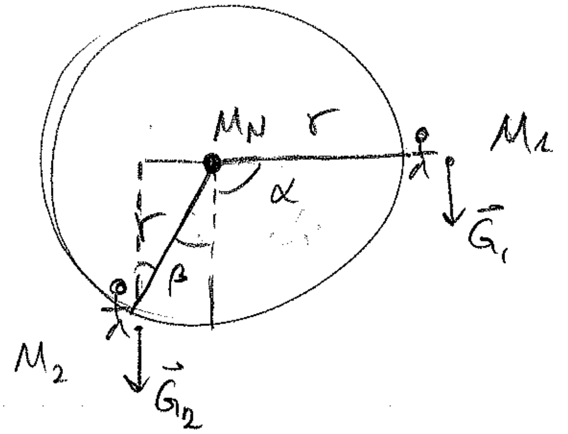
Også: $F_s = G - N$

$N = G - F_s = mg - m a_s =$

$m(g - a_s) = 75.0\,kg \cdot (9.81 - 2.056)\,m/s^2$

$= 581.54\,N \approx \underline{\underline{582\,N}}$

d)



$\alpha = 90^\circ$

$\beta = 2 \cdot 60^\circ - \alpha = 30^\circ$

I ro: $\sum M = M_1 + M_2 + M_N = 0$

$M_1 = - mg \cdot r$

$M_2 = + mg \sin\beta \, r$

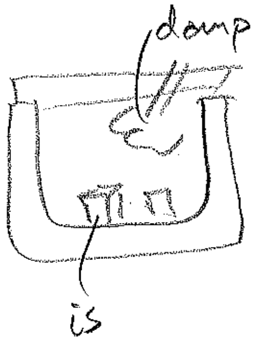
I navet:

$M_N = -M_1 - M_2 = mgr - mgr\sin\beta =$

$mgr(1 - \sin\beta) = 75.0\,\text{kg} \cdot 9.81\,\text{m/s}^2 \cdot 7.50\,\text{m} \cdot (1 - \sin 30^\circ)$

$= 368.88\ \text{Nm} \approx \underline{\underline{368\ \text{Nm}}}$

Oppg. 4



Kalorimeter:

Varmekap. $C' = 0$

Is

Spesifikk smeltevarme: $l_{is} = 334\ \frac{\text{kJ}}{\text{kg}}$

Masse: $m_{is} = 1.0\,\text{kg}$

Temperatur: $t_{is} = 0^\circ\text{C}$

Vatn

Spesifikk varmekapasitet: $c_{vatn} = 4.18\ \frac{\text{kJ}}{\text{kg} \cdot \text{K}}$

Damp

Spesifikk kondenseringsvarme: $l_{damp} = 2.26 \frac{MJ}{kg}$

Masse: $m_{damp} = 1.0 kg$

Temperatur: $t_{damp} = 100°C$

Kondensering av dampen gir varmen

$Q_{kond} = l_{damp} \cdot m_{damp} = 2.26 \frac{MJ}{kg} \cdot 1.0 kg = 2.26 \cdot 10^6 J$

Smelting av isen krever varmen

$Q_{smelt} = l_{is} \cdot m_{is} = 334 \frac{kJ}{kg} \cdot 1.0 kg = 334 \cdot 10^3 J < Q_{kond}$

Vi har nok varme til å smelte all isen.

Oppvarming av smelta is til 100°C krever

$Q_{vatn} = c_{vatn} m_{is} (100 - 0) K =$

$4.18 \frac{kJ}{kg \cdot K} \cdot 1.0 kg \cdot 100 K = 418 \cdot 10^3 J$

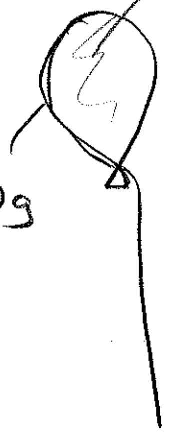
$Q_{smelt} + Q_{vatn} = (334 + 418) \cdot 10^3 J =$

$752 \cdot 10^3 J < Q_{kond}$

Altså: Når all isen er smelta og varma opp til 100°C, er framleis ikkje all dampen kondensert. Sluttemperaturen blir <u>100°C</u>

Oppg. 5

He, 10.0 g = m



$m_b = 15.0\,g$

luft

$p = 1.01 \cdot 10^5\,Pa$ } Normaltilstand
$T = 0^\circ C = 273\,K$

Trykk og temp. er den same i ballongen som i lufta.

a) Massen av eit He-atom:

$m_{He} = 4.00\,u$, $\quad 1u = 1.66 \cdot 10^{-27}\,kg$

Talet på atom:

$$N = \frac{m}{m_{He}} = \frac{10.0 \cdot 10^{-3}\,kg}{4.00 \cdot 1.66 \cdot 10^{-27}\,kg} = 1.506 \cdot 10^{24}$$

$$\approx \underline{\underline{1.51 \cdot 10^{24}}}$$

b) Gasslova:

$pV = NkT$

Volum: $$V = \frac{NkT}{p} = \frac{1.506 \cdot 10^{24} \cdot 1.38 \cdot 10^{-23}\,\frac{J}{K} \cdot 273\,K}{1.01 \cdot 10^5\,Pa}$$

$$= 0.05618\,m^3 \approx \underline{56.2\,l}$$

c)

Snordrag: $S = O - G$

Oppdrift: $O = \rho_{luft} V g$

$\rho_{luft} = 1.29 \frac{kg}{m^3}$

$S = \rho_{luft} V g - (m_b + m) g =$

$g(\rho_{luft} V - m_b - m) =$

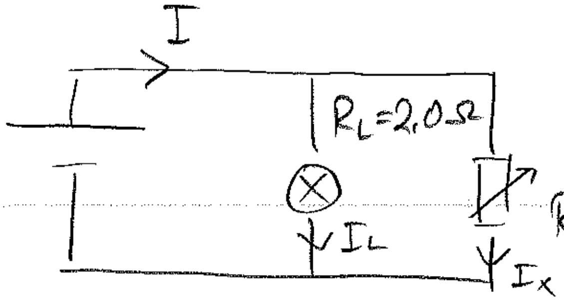
$9.81\ m/s^2 (1.29 \frac{kg}{m^3} \cdot 0.05618\ m^3 - 15.0 \cdot 10^{-3}\ kg - 10.0 \cdot 10^{-3}\ kg) = 0.4657\ N \approx \underline{\underline{0.466\ N}}$

Oppg. 6

$\mathcal{E} = 6.0V$

$U_p = 3.0V$

$R_i = ?$



a) Resultantresistans:

$$\frac{1}{R} = \frac{1}{R_L} + \frac{1}{R_x} = \frac{1}{2.0\Omega} + \frac{1}{\frac{2}{3}\Omega} = 2.0\Omega^{-1}$$

$$R = \frac{1}{2.0\Omega^{-1}} = 0.50\Omega$$

Ohms lov: $U_p = RI$

$$I = \frac{U_P}{R} = \frac{3.0V}{0.50\Omega} = \underline{\underline{6.0A}}$$

b) Polspenning: $U_p = \mathcal{E} - R_i I$

$$R_i = \frac{\mathcal{E} - U_p}{I} = \frac{6.0V - 3.0V}{6.0A} = \underline{\underline{0.50\Omega}}$$

c) Effekt i lampa:

$$P_L = U_p I_L = U_p \cdot \frac{U_p}{R_L} = \frac{U_p^2}{R_L} = \frac{(3.0V)^2}{2.0\Omega} = \underline{\underline{4.5W}}$$

d) No: $P_L = 8.0W$

Framleis: $P_L = \frac{U_p^2}{R_L}$

$$U_p = \sqrt{P_L R_L} = \sqrt{8.0W \cdot 2.0\Omega} = \underline{\underline{4.0V}}$$

e) Ny resultantresistans: R

Ohms lov: $U_p = RI$

$$\mathcal{E} - R_i I = RI \iff R = \frac{\mathcal{E}}{I} - R_i$$

Straumen er gitt ved $U_p = \mathcal{E} - R_i I$

$$I = \frac{\mathcal{E} - U_p}{R_i} = \frac{(6.0 - 4.0)V}{0.50\Omega} = 4.0A$$

Det gir:

$$R = \frac{\mathcal{E}}{I} - R_i = \frac{6.0V}{4.0A} - 0.50\Omega = 1.0\Omega$$

Vidare:

$$\frac{1}{R} = \frac{1}{R_L} + \frac{1}{R_x}$$

$$\frac{1}{R_x} = \frac{1}{R} - \frac{1}{R_L} = \frac{1}{1.0\,\Omega} - \frac{1}{2.0\,\Omega} = 0.50\,\Omega^{-1}$$

$$R_x = \frac{1}{0.50\,\Omega^{-1}} = \underline{\underline{2.0\,\Omega}}$$

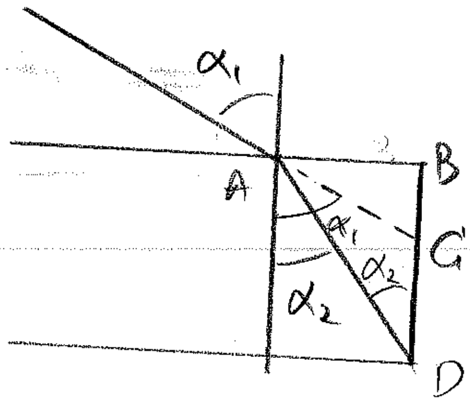
Oppg. 7

a) Trykk: $p = p_0 + \rho g h$

der $p_0 = 1.0$ atm og $\rho = 1.025 \cdot 10^3 \frac{kg}{m^3}$ for saltvatn og $h = 8.0$ m er gitt.

$$p = 1.0 \cdot 1.01 \cdot 10^5\ Pa + 1.025 \cdot 10^3 \frac{kg}{m^3} \cdot 9.81\ m/s^2 \cdot 8.0\ m =$$
$$1.8144 \cdot 10^5\ Pa \approx \underline{\underline{1.8 \cdot 10^5\ Pa}}$$

b)



$AB = 29.3$ cm

$\alpha_1 = 60.0°$

Ser: $\frac{BG}{AB} = \tan(90° - \alpha_1)$

$$BG = AB \tan(90° - \alpha_1) =$$
$$29.3\ cm \tan(90° - 60°) = \underline{\underline{16.9\ cm}}$$

c) Gitt: $BD = 41.0\,cm$

Snells brytingslov:

$n_{luft} \sin\alpha_1 = n \sin\alpha_2$

der $n_{luft} = 1.00$ og n er brytingsindeksen

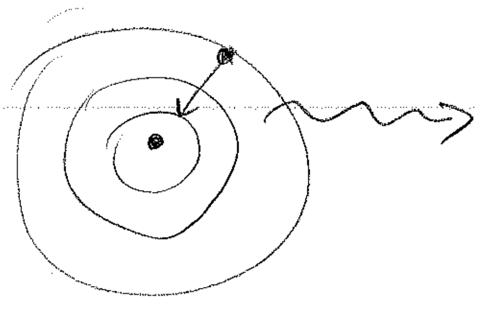
for akryl.

Ser: $\frac{AB}{BD} = \tan\alpha_2$

$$\alpha_2 = \arctan\frac{AB}{BD} = \arctan\frac{29,3}{41.0} = 35.55°$$

$$n = \frac{n_{luft}\sin\alpha_1}{\sin\alpha_2} = \frac{1.00\cdot\sin 60°}{\sin 35.55°} = 1.489 \approx \underline{\underline{1.49}}$$

Oppg. 8



a) Energi-endring: $E_4 - E_2$ der

$E_n = -\frac{B}{n^2}$, $B = 2.18\cdot10^{-18}\,J$

Foton-energi: $E = hf$ der f er

frekvensen og $h = 6.63\cdot10^{-34}\,Js$

Videre er bølgelengde $\lambda = \frac{c}{f}$ der

$c = 3.00 \cdot 10^8 \, m/s$

Alt i alt:

$h \frac{c}{\lambda} = \left(-\frac{B}{m^2}\right) - \left(-\frac{B}{n^2}\right)$ der $m=4$ og $n=2$

$$\frac{hc}{\lambda} = B\left(\frac{1}{n^2} - \frac{1}{m^2}\right)$$

$$\lambda = \frac{hc}{B\left(\frac{1}{n^2} - \frac{1}{m^2}\right)} = \frac{6.63 \cdot 10^{-34} \, Js \cdot 3.00 \cdot 10^8 \, m/s}{2.18 \cdot 10^{-18} \, J \left(\frac{1}{2^2} - \frac{1}{4^2}\right)}$$

$$= 4.8661 \cdot 10^{-7} \, m \approx \underline{\underline{487 \, nm}}$$

b) $f = \frac{c}{\lambda} = \frac{3.00 \cdot 10^8 \, m/s}{4.8661 \cdot 10^{-7} \, m} = 6.1652 \cdot 10^{14} \, \frac{1}{s} \approx$

$$\underline{\underline{6.17 \cdot 10^{14} \, Hz}}$$