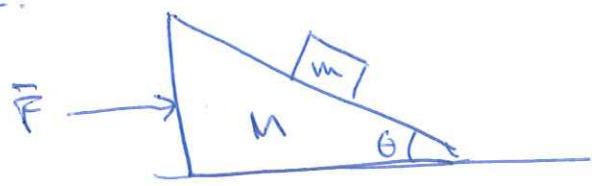
1.

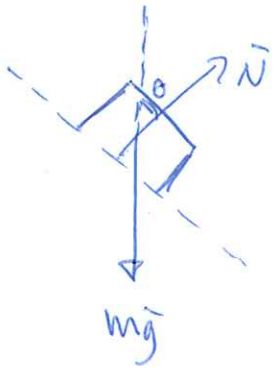


$m = 1{,}2\ kg$

$M = 5{,}3\ kg$

$\theta = 38°$

Fokusera lilla kilen:



Kraft för att kilen inte ska röra sig i y-led:

$$N\cos\theta = mg$$

Kraftbalans i x-led:

$$N\sin\theta = ma$$

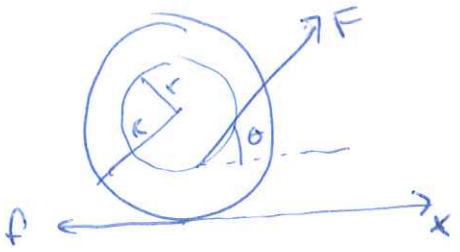
$$\Rightarrow \frac{mg}{\cos\theta}\sin\theta = ma$$

$$a = g\frac{\sin\theta}{\cos\theta} = g\tan\theta$$

Hela systemet:

$$F = (m+M)a = (m+M)g\tan\theta = \underline{49{,}8\ N}$$

2.



$F = 2{,}3\ N$

$\theta = 55°$

$R = 6{,}0\ cm$

$M = 50\ g$

$r = 4\ cm$

$m = 40\ g$

$\sum F: \quad \cos\theta F - f = M_{tot}\, a_{cm}$

$\sum \mathcal{T}: \quad Fr - fR = -I \frac{a_{cm}}{R}$

$\Rightarrow f = \cos\theta F - M_{tot} \cdot a_{cm}$

$\Rightarrow Fr - (\cos\theta F - M_{tot} a_{cm}) R = -I \frac{a_{cm}}{R}$

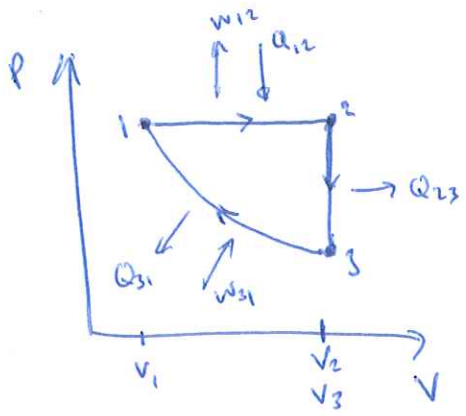
$\Rightarrow a_{cm} = \frac{\cos\theta FR^2 - FrR}{M_{tot} R^2 + I}$

$M_{tot} = 2 \cdot M + m = 140\ g = 0{,}14\ kg$

$I = MR^2 + \frac{1}{2} m r^2 = 2{,}12 \cdot 10^{-4}\ kg\, m^2$

$a_{cm} = -1{,}0765 = -1{,}1\ m/s^2$ (; neg. x-richt.)

3.



Enthalpy gas: $C_V = \frac{3}{2}R$

$C_P = \frac{5}{2}R$

$\frac{T_2}{T_2} = \frac{T_2}{T_1} = 1{,}53$

$$e = \frac{W_{nutto}}{Q_{HEATER}} = \frac{W_{12} + W_{31}}{Q_{12}}$$

$$W_{31} = nRT_1 \ln\frac{V_1}{V_3} \quad , \quad \frac{V_1}{V_3} = \frac{V_1}{V_2}$$

$$\left.\begin{aligned} P_1V_1 &= nRT_1 \\ P_1V_2 &= nRT_2 \end{aligned}\right\} \Rightarrow \frac{V_1}{V_2} = \frac{T_1}{T_2} \quad , \quad T_2 = 1{,}53 \cdot T_1$$

$$\frac{T_1}{T_2} = \frac{1}{1{,}53}$$

$$\Rightarrow W_{31} = nRT_1 \ln\frac{T_1}{T_2}$$

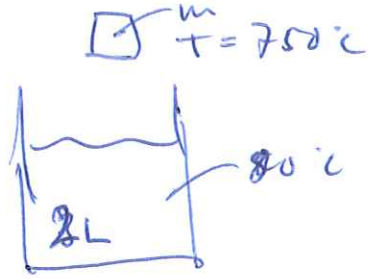
$$W_{12} = P_1(V_2 - V_1) = nR(T_2 - T_1)$$

$$Q_{12} = \Delta U_{12} + W_{12} = nC_P(T_2 - T_1) = n\frac{5}{2}R(T_2 - T_1)$$

$$e = \frac{nR(T_2 - T_1) + nRT_1 \ln\frac{T_1}{T_2}}{n\frac{5}{2}R(T_2 - T_1)} = \frac{T_1(1{,}53 - 1) + T_1\ln\left(\frac{1}{1{,}53}\right)}{\frac{5}{2}T_1(1{,}53 - 1)} =$$

$$= 0{,}079 = \underline{7{,}9\,\%}$$

4.



$T_v = 80\,°C$

$m_v = 2{,}0\,kg$

$m_j = 1{,}0\,kg$

$T_j = 750\,°C$

När järn och vatten är 100 °C har de samma T.

Värmd vatten 20 → 100 °C:

$Q_1 = m_v c_{vatten} \cdot (100 - 20) = 167{,}100\,kJ$

Kyla järnet 750 − 100 °C

$Q_2 = m_j c_{järn} (750 - 100) = 305{,}5\,kJ$

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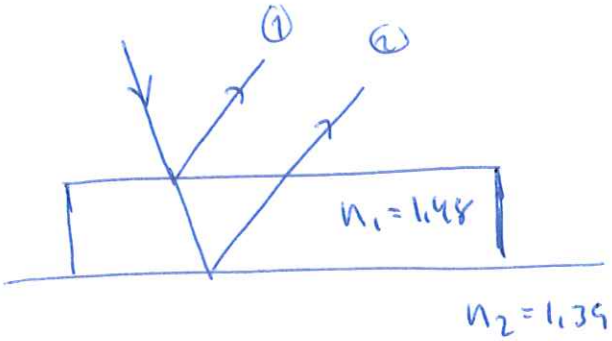
förlorat vatten.

$Q_3 = Q_2 - Q_1 = 137{,}9\,kJ$

$Q_3 = m_{\text{å}} L_{\text{smältn}}$

$m_{\text{å}} = \dfrac{Q_3}{L_{\text{smältn}}} = 0{,}064\,kg = \underline{64{,}1\,g}$

5.



max vid:

$\lambda_1 = 693$ nm

$\lambda_2 = 567$ nm

Kollaps för maximum:

$2 n_1 d = \left(m + \frac{1}{2}\right) \lambda$ (ett fasspräng)

$2 n_1 d = \left(m_1 + \frac{1}{2}\right) \lambda_1$

$2 n_1 d = \left(m_2 + \frac{1}{2}\right) \lambda_2$

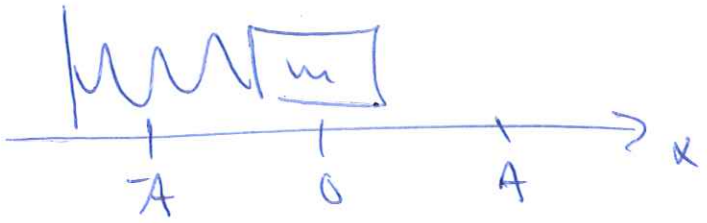
$m_2 = m_1 + 1 = m$

$$\Rightarrow m = \frac{\frac{3}{2}\lambda_2 - \frac{1}{2}\lambda_1}{\lambda_1 - \lambda_2} = 4$$

$$d = \frac{\left(m + \frac{1}{2}\right)\lambda_1}{2 n_1} = \underline{1{,}05 \ \mu m}$$

$$\left(d = \frac{\left(m + \frac{3}{2}\right)\lambda_2}{2 n_1} = 1{,}05 \ \mu m \right)$$

6.



$m = 1{,}5\ kg$

$k = 200\ N/m$

$v_{max} = 2{,}2\ m/s$

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

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

$$v_{max} = A\sqrt{\frac{k}{m}} = 2{,}2 \Rightarrow \underline{A = 0{,}1905\ m}$$

$$a = \frac{dv}{dt} = -A\frac{k}{m}\cos\left(\sqrt{\frac{k}{m}}\,t\right)$$

$$a_{max} = A\frac{k}{m} = \underline{25{,}4\ m/s^2}$$

a_{max} när $\cos\left(\sqrt{\frac{k}{m}}\,t\right) = 1$ el. -1

a_{max} vid $x = A$ el. $-A$.