

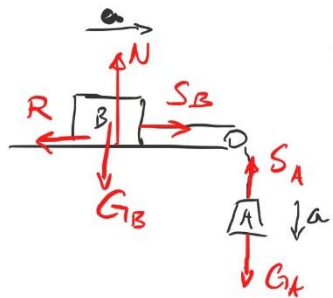
Løsning Tentamen mars 2021

1 a) Oppdrift = Tyngdekraft = massen til forstengt vann
 Newtons 1. Arkimedes

\Rightarrow (C)

b)
$$a = \frac{4\pi^2 r}{T^2} = \frac{4\pi^2 6378 \cdot 10^3}{(24 \cdot 60 \cdot 60)^2} = 3,4 \cdot 10^{-2} \text{ m/s}^2$$

2 a)



b) Newtons 2. $S_A = S_B = S$
 $a_A = a_B = a$

A: $G_A - S = m_A a$

B: $S_B - R = m_B a$

$R = \mu \cdot N = \mu m_B g$

$m_A g - S = m_A a$

$+ S - \mu m_B g = m_B a$

$\rightarrow m_A g - \cancel{S} + \cancel{S} - \mu m_B g = \underbrace{m_A a + m_B a}_{a(m_A + m_B)}$

$\Rightarrow a = \frac{m_A g - \mu m_B g}{m_A + m_B}$

$= \frac{2 \cdot 9,81 - 0,4 \cdot 4 \cdot 9,81}{2 + 4} = \underline{\underline{0,65 \text{ m/s}^2}}$

$$2c) \quad m_A g - S = m_A a$$

$$\Rightarrow S = m_A g - m_A a = 2 \cdot 9,81 - 2 \cdot 0,65 = \underline{\underline{18 \text{ N}}}$$

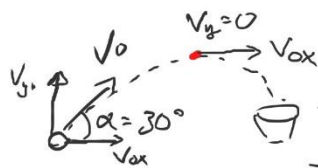
$$d) \quad S = \frac{1}{2} a t^2 + \cancel{v_0 t} + \cancel{x_0} \Rightarrow a = \frac{2s}{t^2} = \frac{2 \cdot 2}{1,5^2} = 1,78 \text{ m/s}^2$$

$$\rightarrow m_A g - \mu m_B g = (m_A + m_B) a$$

$$\Rightarrow \mu = \frac{m_A g - (m_A + m_B) a}{m_B g}$$

$$= \frac{2 \cdot 9,81 - (2 + 4) \cdot 1,78}{4 \cdot 9,81} = \underline{\underline{0,23}}$$

3a)



$$a_y = -g, \quad a_x = 0$$

$$v_y = a_y t + v_{0y} \Rightarrow v_{0y} = -a_y t = g \cdot t = 9,81 \cdot 0,48 = \underline{\underline{4,7 \text{ m/s}}}$$

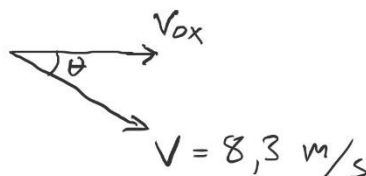
b) 1 toppunkt er $v = v_{0x}$

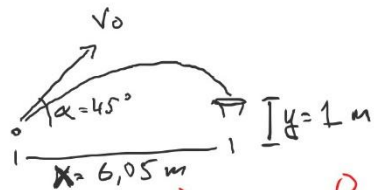
$$\tan \alpha = \frac{v_{0y}}{v_{0x}}$$

$$\Rightarrow v_{0x} = \frac{v_{0y}}{\tan \alpha} = \underline{\underline{8,16 \text{ m/s}}}$$

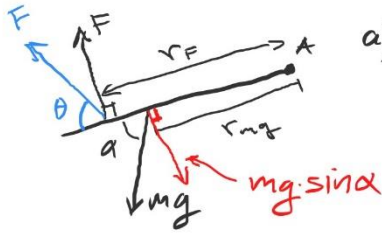
$$c) \quad \frac{1}{2} m \cancel{v_0^2} = \frac{1}{2} m \cancel{v^2} + 2 m g h$$

$$\Rightarrow v = \sqrt{v_0^2 - 2gh} = \sqrt{v_{0x}^2 + v_{0y}^2 - 2gh} = \underline{\underline{8,3 \text{ m/s}}}$$

d)  $\cos \theta = \frac{V_{ox}}{V}$
 $\theta = \cos^{-1}\left(\frac{V_{ox}}{V}\right) = \underline{\underline{10,9^\circ}}$
 $= \underline{\underline{-10,9^\circ}}$

e)  $V_{0x} = V_0 \cos \alpha$, $V_{0y} = V_0 \sin \alpha$
 $x: x = \frac{1}{2} a_x t^2 + V_{0x} t + x_0 \Rightarrow t = \frac{x}{V_{0x}} = \frac{x}{V_0 \cos \alpha}$
 $y: y = \frac{1}{2} a_y t^2 + V_{0y} t + y_0 = -\frac{1}{2} g \frac{x^2}{V_0^2 \cos^2 \alpha} + \underbrace{V_0 \sin \alpha}_{V_{0y}} \cdot \frac{x}{V_0 \cos \alpha}$
 $y = -\frac{g \cdot x^2}{2 V_0^2 \cos^2 \alpha} + x \cdot \tan \alpha$
 $V_0 = \sqrt{\frac{g x^2}{2 \cos^2 \alpha (x \cdot \tan \alpha - y)}} = \underline{\underline{8,43 \text{ m/s}}}$

4



$$a) M_{mg} = r_{mg} \cdot mg \cdot \sin \alpha$$

$$= 0,7 \cdot 10 \cdot \sin 60 = \underline{\underline{6,06 \text{ Nm}}}$$

$$b) \text{ Lihevericht} \rightarrow \Sigma M = 0 \quad M_F = M_{mg}$$

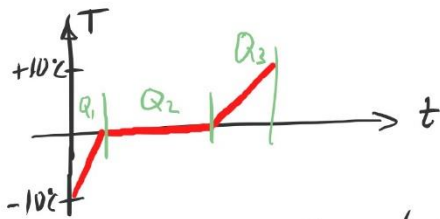
$$M_F = r_F \cdot F \Rightarrow F = \frac{M_{mg}}{r_F} = \frac{6,06}{1,05} = \underline{\underline{5,77 \text{ N}}}$$

$$c) \Sigma M = 0 \quad M_{mg} = M_F = r_F \cdot F \cdot \sin \theta$$

$$\Rightarrow \sin \theta = \frac{M_{mg}}{r_F \cdot F}$$

$$\Rightarrow \theta = \sin^{-1} \left(\frac{6,06}{105 \cdot 10} \right) = \underline{\underline{35,2^\circ}}$$

5 a)



$$b) Q_1 = c_{is} \cdot m \cdot \Delta T \quad (is \text{ } -10^\circ\text{C} \rightarrow 0^\circ\text{C})$$

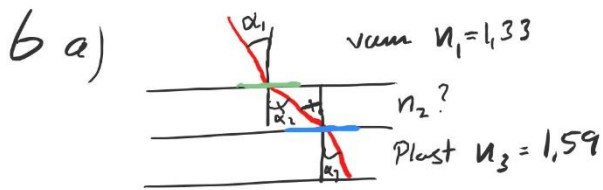
$$Q_2 = mL \quad (\text{smelte varmen})$$

$$Q_3 = c_{vann} \cdot m \cdot \Delta T \quad (\text{vann } 0^\circ\text{C} \rightarrow +10^\circ\text{C})$$

$$Q_{tot} = Q_1 + Q_2 + Q_3 = \underline{2,1} \cdot \underline{2,5} \cdot 10 + 2,5 \cdot \underline{334} + \underline{4,2} \cdot 2,5 \cdot 10$$

$$= 990 \text{ kJ}$$

$$c) P = \frac{Q_{tot}}{t} \Rightarrow t = \frac{Q_{tot}}{P} = \frac{990 \cdot 10^3}{500} = 1,8 \cdot 10^3 \text{ s} = \underline{\underline{30 \text{ min}}}$$



a) Snells brytningslov

$$n_1 \sin \alpha_1 = n_2 \sin \alpha_2 \Rightarrow n_2 = \frac{n_1 \sin \alpha_1}{\sin \alpha_2} = \underline{\underline{1,10}}$$

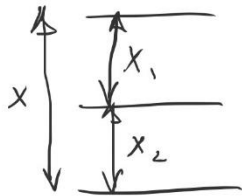
b) $n_2 \sin \alpha_2 = n_3 \sin \alpha_3 \Rightarrow \alpha_3 = \sin^{-1} \left(\frac{n_2 \sin \alpha_2}{n_3} \right) = \underline{\underline{28,7^\circ}}$

c) Totalrefleksjon i øverste flate (n₁ > n₂)

$$n_1 \sin \alpha_{gr} = n_2 \sin 90$$

$$\Rightarrow \alpha_{gr} = \sin^{-1} \left(\frac{n_2}{n_1} \right) = \underline{\underline{55,8^\circ}}$$

6 d)



$$x_1 = 2,5 \text{ cm} \pm 1\%$$

$$x_2 = 2,1 \text{ cm} \pm 1\%$$

Absolutt usikkerhet

$$\Delta x_1 = 2,5 \cdot 0,01 = 0,025 \text{ cm}$$

$$\Delta x_2 = 2,1 \cdot 0,01 = 0,021 \text{ cm}$$

$$x = x_1 + x_2 = 4,6 \text{ cm}$$

$$\Delta x = \Delta x_1 + \Delta x_2 = 0,046 \text{ cm}$$

$$\frac{\Delta x}{x} = \frac{0,046}{4,6} \approx 0,01 = 1\%$$

$$\underline{\underline{x = 4,6 \text{ cm} \pm 1\%}}$$