Barem / Javítókulcs:

Problema 1. Feladat

a) (15 p)

$m_A g \sin(\alpha) - \mu m_A g \cos(\alpha) = m_A a \Rightarrow a = g(\sin(\alpha) - \mu \cos(\alpha)) = 4,13 \text{ m/s}^2$

Din relația lui Galilei / Galilei képlet alapján $v^2 = v_0^2 + 2a(x - x_0)$, unde/ahol $x - x_0 = h/\sin(\alpha)$ și/és $v_0 = 0 \Rightarrow v_A = \sqrt{2a\frac{h}{\sin(\alpha)}} = 2,6 \text{ m/s}$.

$v_A = v_0 + a t_c \Rightarrow t_c = \frac{v_A}{t_c} = 0,63 \text{ s}$.

b) (10 p)

Conservare de impuls / impulzusmegmaradás: $m_A \vec{v}_A + m_B \vec{v}_B = m_A \vec{v}'_A + m_B \vec{v}'_B$

Conservare de energie / Energiamegmaradás: $\frac{m_A v_A^2}{2} + \frac{m_B v_B^2}{2} = \frac{m_A (v'_A)^2}{2} + \frac{m_B (v'_B)^2}{2}$

$\Rightarrow \vec{v}'_A = 2\frac{m_A \vec{v}_A + m_B \vec{v}_B}{m_A + m_B} - \vec{v}_A; \quad \vec{v}'_B = 2\frac{m_A \vec{v}_A + m_B \vec{v}_B}{m_A + m_B} - \vec{v}_B$

Deoarece / Mivel $m_A \vec{v}_A + m_B \vec{v}_B = 0 \Rightarrow \vec{v}'_A = -\vec{v}_A; \quad \vec{v}'_B = -\vec{v}_B$

c) (10 p)

Conservare de energie/ energiamegmaradás: $\frac{m_B v_B^2}{2} + \frac{k x_B^2}{2} = \frac{k x_{max}^2}{2} \Rightarrow x_{max} = \sqrt{x_B^2 + \frac{m_B v_B^2}{k}} = \sqrt{x_B^2 + \frac{2m_A v_A^2}{k}} = 17,3 \text{ m}$

d) (10 p)

$a = 0 \Rightarrow \mu_l = \tan(\alpha) = 0,57; \quad \mu > \mu_l = 0,57$

Problema 2. Feladat

a) (10 p)

$$p_1 = p_0 + 2\rho g h_1 = 800 \, \text{mmHg} \approx 108800 \, \text{Pa} \tag{1}$$

b) (10 p)

$$V_1 = V_0 + h_1 S = 840 \text{ cm}^3 \quad \Rightarrow \quad T_1 = \frac{p_1 V_1}{p_0 V_0} T_0 \approx 301.7 \ K \tag{2}$$

c) (10 p)

$$p(V) = p_0 + \frac{2\rho g}{S}(V - V_0) \tag{3}$$

Reprezentarea grafică/A függvény grafikus ábrázolása: Fig. 1.

d) (15 p)

$$L' = \frac{1}{2}(p_0 + p_1)(V_1 - V_0) \approx 4.24 \text{ J} \tag{4}$$

$$\Delta U = \nu C_v (T_1 - T_0) = \frac{5}{2}(p_1 V_1 - p_0 V_0) \approx 21.76 \text{ J} \tag{5}$$

$$Q = \Delta U + L' = 26 \text{ J} \tag{6}$$

Puterea de încălzire fiind/A fűtőszál teljesítménye $P = 2W$:
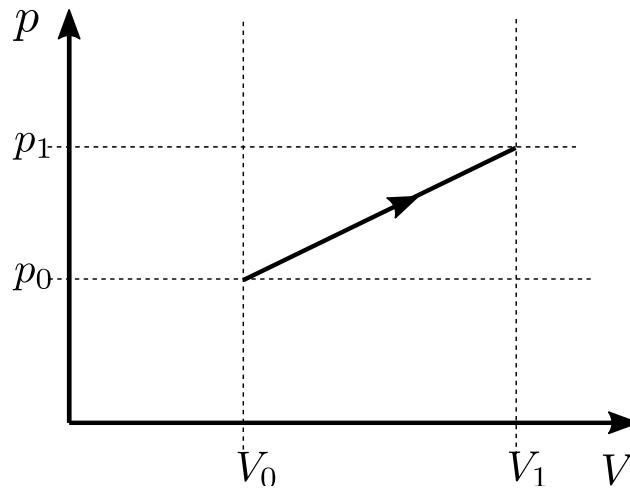
$$\Delta t = \frac{Q}{P} = 13\,\text{s} \tag{7}$$

Figura 1: Transformarea de stare în coordonatele (p, V)./ Állapotváltozás a (p, V) síkban.

Problema 3. Feladat

a) (10 p)

$$R_{ech} = [(\{4\Omega \parallel 12\Omega\} + 2\Omega) \parallel (\{5\Omega \parallel 20\Omega\} + 11\Omega + 5\Omega)] + [10\Omega \parallel 10\Omega \parallel 20\Omega] + 7\Omega = 15\Omega$$

b) (10 p)

$$I = \frac{E_{ech}}{R_{ech} + r_{ech}} = \frac{6E}{R_{ech} + 6r} \Rightarrow r = \frac{E}{I} - R_{ech}/6 = 0,5 \ \Omega$$

c) (10 p)

$$R_{AB} = 4\Omega; U_{AB} = R_{AB}I = 4 \ V$$
$$U_{BC} = 0 \ V$$
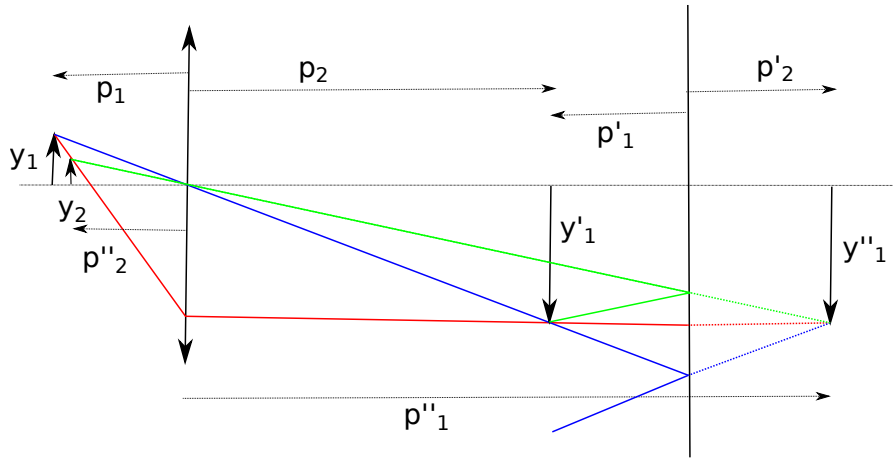$$R_{CD} = 4\Omega; U_{CD} = R_{CD}I = 4 \ V$$

d) (15 p)

$$R'_{ech} = R_{AB} + 7\Omega = 11\Omega$$
$$I' = \frac{E_{ech}}{R'_{ech} + r_{ech}} = \frac{9}{7} \ A$$
$$\Delta I = I' - I = \frac{2}{7} \ A$$

Problema 4. Feladat

a) (10 p)

$$p_2 - p_1 = d; \quad \gamma = \frac{p_2}{p_1} \Rightarrow p_1 = \frac{d}{\gamma - 1}; p_2 = \gamma \frac{d}{\gamma - 1}$$

$$d = 36 \ cm; \gamma = -5 \Rightarrow p_1 = -6 \ cm; p_2 = 30 \ cm$$

$$\frac{1}{p_2} - \frac{1}{p_1} = \frac{1}{f} \Rightarrow f = \frac{p_1 p_2}{p_1 - p_2} = 5 \ cm$$

b) (10 p)

$$C = \frac{1}{f} = \frac{1}{0.05} m^{-1} = 20 \ dioprii$$

$$\frac{1}{f} = \frac{n_r - 1}{R} \Rightarrow R = f(n_r - 1) = 2 \ cm$$

c) (15 p)

$$L = p_2 - p_1' \Rightarrow p_1' = p_2 - L = -10 \ cm$$

$$p_1' + p_2' = 0 \Rightarrow p_2' = -p_1' = 10 \ cm$$

$$p_1'' = -p_2 - p_2' + p_1' = -50 \ cm$$

$$\frac{1}{p_2''} - \frac{1}{p_1''} = \frac{1}{f} \Rightarrow p_2'' = \frac{p_1'' f}{p_1'' + f} = 5, (5) \ cm$$

$$y_2 = y_1'' \frac{p_2''}{p_1''} = y_1'' \frac{f}{f + p_1''} = (y'' = -5 \ mm) \frac{5cm}{-45cm} = \frac{5}{9} \ mm.$$

d) (10 p) Dacă y_1 şi y_2 coincid / ha y_1 és y_2 egybeesik:

$$p_2'' = -p_1 = 6 \ cm \Rightarrow p_1'' = -30cm \Rightarrow$$

Imaginea y_1'' formată de oglindă trebuie să coincidă cu obiectul intermediar $y_1' \Rightarrow$ poziţia oglindei trebuie să coincidă cu poziţia imaginii intermediare formată de letilă, adică $L' = 30$ cm.

A tükör által alkotott y_1'' kép egybe kell essen az y_1' közbeeső tárggyal $\Rightarrow$ A tükör helyzete meg kell egyezzen a lencse által alkotott y_1' közbeeső kép helyzetével, azaz $L' = 30$ cm.