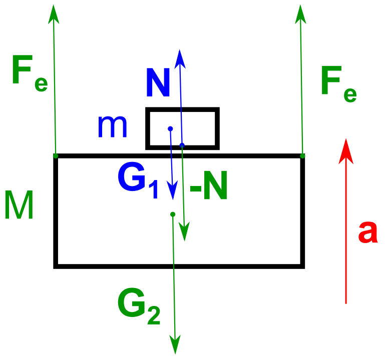
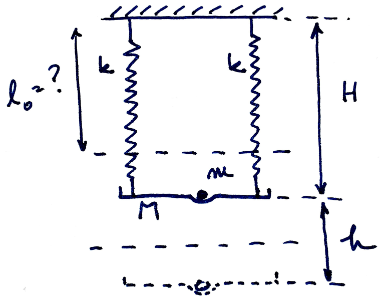
Barem / Javítókulcs

Problema 1. Feladat





$$m\vec{a} = \vec{N} + \vec{G}_1 \Rightarrow ma = N - mg \tag{1}$$

$$M\vec{a} = 2\vec{F}_e - \vec{N} + \vec{G}_2 \Rightarrow Ma = 2F_e - N - Mg \tag{2}$$

$$a(M+m) = 2F_e - (M+m)g \tag{3}$$

a) (8 p)

$$a = 0; (3) \Rightarrow 2F_e = 2kx_0 = (M+m)g \Rightarrow x_0 = \frac{(M+m)g}{2k}$$

$$H = l_0 + x_0 \Rightarrow l_0 = H - x_0 = H - \frac{(M+m)g}{2k}$$

b) (7 p)

$$(3) \Rightarrow a = \frac{2F_e}{M+m} - g = \frac{2k(x_0+h)}{M+m} - g = \frac{2kh}{M+m}$$

c) (10 p)

$$(1) \Rightarrow a = \frac{N}{m} - g$$

$$(2) \Rightarrow a = \frac{2F_e}{M} - \frac{N}{M} - g = \frac{N}{m} - g \Rightarrow \frac{2F_e}{M} = N\left(\frac{1}{m} + \frac{1}{M}\right)$$

$$\Rightarrow N = \frac{2F_e m}{M+m}$$

In momentul desprindere $N = 0$/ levalas pillanataban $N = 0$

$$N = 0 \Rightarrow F_e = 0 \Rightarrow x = 0$$

d) Conservare de energie / energiamegmaradas:

$$\frac{kx^2}{2} = \frac{(M+m)v^2}{2} + mgx; \quad x = h + x_0$$

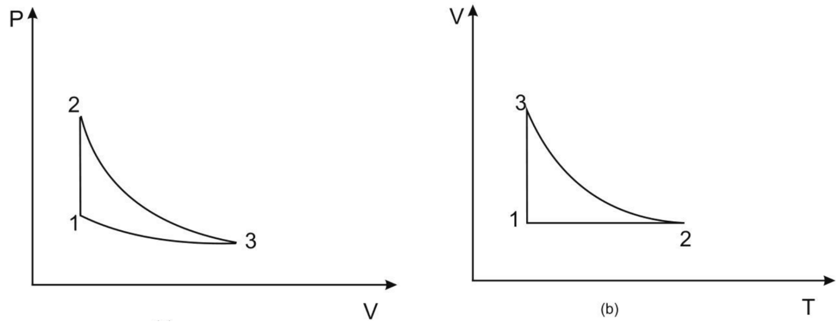
$$k(h+x_0)^2 = (M+m)v^2 + 2mg(h+x_0)$$

$$v^2 = \frac{k(h+x_0)^2 - 2mg(h+x_0)}{M+m} \Rightarrow v = \sqrt{\frac{k(h+x_0)^2 - 2mg(h+x_0)}{M+m}}$$

aruncare bilei - conservarea energiei / a golyo hajitasa - energiamegmaradas:

$$\frac{mv^2}{2} = mg\Delta h \Rightarrow \Delta h = \frac{v^2}{2g} = \frac{k(h+x_0)^2}{2(M+m)g} - \frac{m(h+x_0)}{M+m}$$

Problema 2. Feladat a) (5 p)



b) (15 p)

$$3 \rightarrow 1 : p_1V_1 = p_3V_3 \Rightarrow V_1 = V_3\frac{p_3}{p_1} = 1\ \text{m}^3 = V_2$$

$$2 \rightarrow 2 : p_2V_1^{\gamma} = p_3V_3^{\gamma} \Rightarrow p_2 = p_3\left(\frac{V_3}{V_1}\right)^{\gamma} = 2^{\frac{7}{5}} \cdot 10^5 N/m^2 \simeq 2.64 \cdot 10^5 N/m^2$$

c) (15 p)

In destinderea adiabatica:/ Adiabatikus tagulas eseten $Q_{23} = 0 \Rightarrow L_{23} = -\Delta U_{23} = -\nu C_V(T_3 - T_2)$

$$2 \rightarrow 3 : T_2V_1^{\gamma-1} = T_3V_3^{\gamma-1} \Rightarrow \frac{T_2}{T_3} = \left(\frac{V_3}{V_1}\right)^{\gamma-1} = \epsilon^{\gamma-1}$$

$$L_{23} = \nu C_V T_3(\frac{T_2}{T_3} - 1) = \nu C_V T_3(\epsilon^{\gamma-1} - 1); \quad \nu T_3 = \frac{p_3V_3}{R} = \frac{p_3V_3}{C_p - C_V} \Rightarrow$$

$$L_{23} = \frac{C_V p_3V_3}{C_p - C_V}(\epsilon^{\gamma-1} - 1) = \frac{p_3V_3}{\frac{C_p}{C_V} - 1}(\epsilon^{\gamma-1} - 1) = \frac{p_3V_3}{\gamma - 1}(\epsilon^{\gamma-1} - 1)$$

$$\epsilon = \frac{V_3}{V_1} = \frac{p_1}{p_3} \Rightarrow L_{23} = \frac{p_3V_3}{\gamma - 1}\left(\left(\frac{p_1}{p_3}\right)^{\gamma-1} - 1\right) \simeq 1,6 \cdot 10^5\text{Nm} = 1,6 \cdot 10^5\text{J}$$

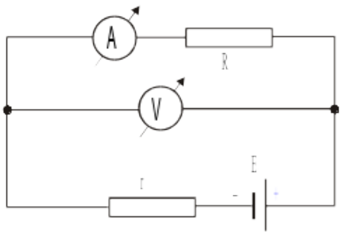
d) (5 p)

$$Q_{23} = 0 \Rightarrow \Delta U_{23} = -L_{23} = -1,6 \cdot 10^5\text{J}$$

e) (5 p)

$$\eta = 1 - \frac{|Q_{13}|}{|Q_{12}|} = 1 - \frac{\nu RT_1 \ln\left(\frac{V_3}{V_1}\right)}{\nu C_V(T_2 - T_1)} = 1 - \frac{C_V\left(\frac{C_p}{C_V} - 1\right)T_1\ln(\epsilon)}{C_VT_1(\frac{T_2}{T_1} - 1)} = 1 - \frac{(\gamma - 1)\ln(\epsilon)}{\epsilon^{\gamma-1} - 1}$$

Problema 3. Feladat
a) (15 p)



$$E = I(R + r); \quad U = I \cdot R \Rightarrow E = I \cdot r + U \Rightarrow U = E - I \cdot r$$

Pe baza datelor din tabel stabilim functia lineara U(I) / A tablazatbeli adatok alapjan meghatarozzuk az U(I) linearis fuggvenyt

$$U = 12 - 2 \cdot I \Rightarrow E = 12 \text{ V}; \; r = 2 \; \Omega$$

b) (10 p)

$$I_{serie} = \frac{E_{serie}}{r_{serie} + R} = \frac{3E}{3r + R}$$

$$P(R) = I_{serie}^2 R = \frac{9E^2 R}{(3r + R)^2}$$

$$P(R)_{max} = P(R = r_{serie}) \Rightarrow R = 3r = 6 \; \Omega$$

c) (10 p)

$$I_{parallel}(R) = \frac{E_{parallel}}{r_{parallel} + R} = \frac{E}{\frac{r}{3} + R}$$

$$I_{parallel}(R))_{max} = I_{parallel}(R = 0) = \frac{3E}{r} = 18 \text{ A}$$

d) (10 p)
sursa scurtcircuitata ≡ inlocuit cu un conductor ideal (fara rezistenta)
rovidrezart generator ≡ helyetesitheto egy idealis vezetovel (nulla ellenallasu)

$$I_{parallel} = 0 \text{ A}$$

$$I_{serie} = \frac{2E}{2r + R}$$

$$\frac{I_{parallel}}{I_{serie}} = 0$$

Problema 4. Feladat

$f = 10$ cm, $y_1 = 1$ cm

a) $p_1 = -15$ cm

$$\frac{1}{p_2} - \frac{1}{p_1} = \frac{1}{f} \Rightarrow p_2 = \frac{p_1 f}{p_1 + f} = 30\ cm \quad (5p)$$

$$\gamma = \frac{p_2}{p_1} = \frac{30}{-15} = -2; \quad y_2 = \gamma y_1 = -2\ cm \quad (5p)$$

$$\gamma < 1 \Rightarrow \text{imagine rasturnata; forditott allasu kep} \quad (5p)$$

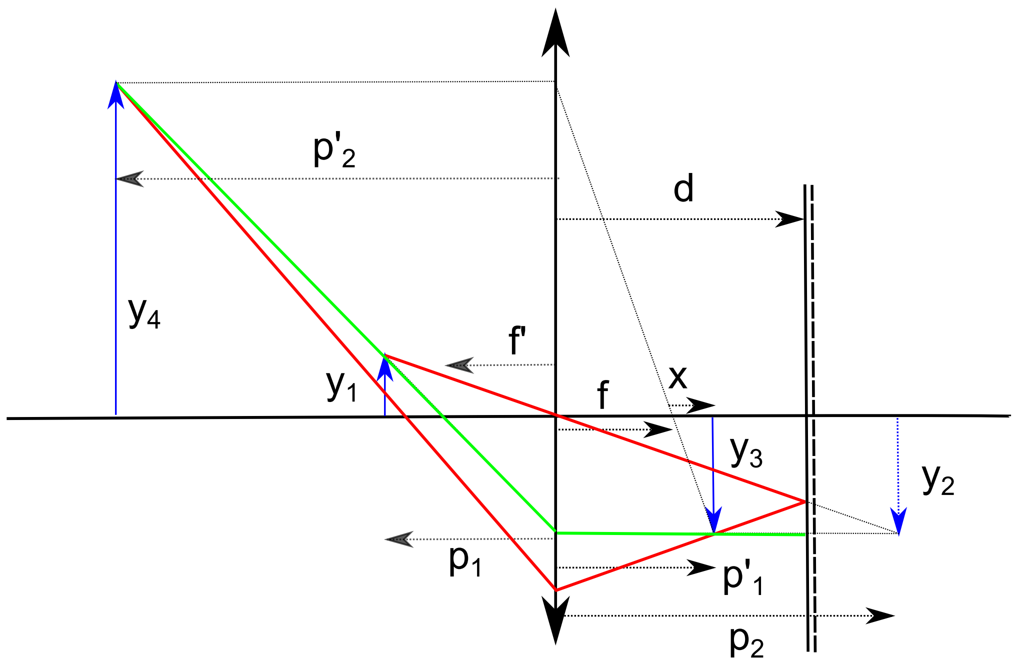
b) $\gamma = -1 \Rightarrow p_2 = -p_1$

$$\frac{1}{p_2} - \frac{1}{p_1} = \frac{1}{f} = -\frac{2}{p_1} \Rightarrow p_1 = -2f = -20\ cm \quad (10p)$$

Lentila trebuie indepartata de obiect cu 5 cm / A lencset 5 cm-el kell eltavolitanunk a targytol

c)

$$\gamma = \frac{y_4}{y_1} = 5; \ \gamma_1 = \frac{y_2}{y_1} - 2; \ \gamma_2 = \frac{y_3}{y_2} = 1; \ \gamma_3 = \frac{y_4}{y_3}; \ \gamma = \gamma_1\gamma_2\gamma_3 \Rightarrow \gamma_3 = \frac{\gamma}{\gamma_1\gamma_2} = -5/2$$



$$\gamma_3 = \frac{-f}{x} \Rightarrow x = \frac{-f}{\gamma_3} = 4\ cm$$

$$d = \frac{p_2 + f + x}{2} = \frac{30 + 10 + 4}{2}\ cm = 22\ cm \quad (15p)$$

d)

$$p_1' = -14\ cm; f' = 10\ cm$$

$$p_2' = \frac{p_1' f'}{p_1' + f'} = \frac{-140}{-4}\ cm = 35\ cm (5p)$$