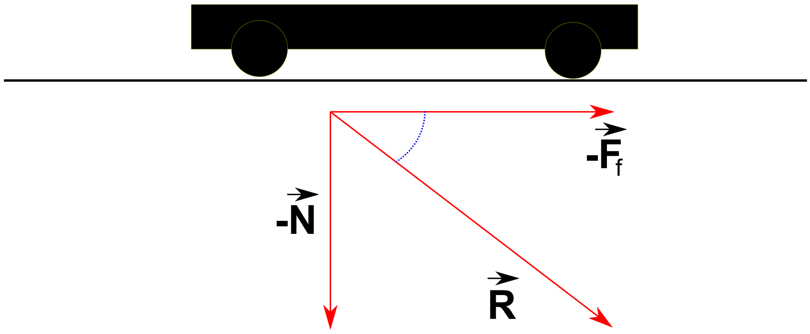
Barem de corectare/Javítókulcs

Problema 1. Feladat

a) 7p

$$d = 100\frac{1000m}{3600s}\left(\frac{3}{2}s + 5s + \frac{5}{2}s\right) = 250m$$

b) 10p



$$N = mg = 2 \cdot 10^3 \cdot 10 = 20\ kN$$

$$a_3 = \frac{v_{max}}{\Delta t_3} = \frac{100}{5}\frac{1000}{3600}\frac{m}{s^2} = 5.(5)\frac{m}{s^2}$$

$$F_f = ma_3 = 2 \cdot 10^3 \cdot 5.5(5)N = 11.(1)\ kN$$

$$R = \sqrt{N^2 + F_f^2} = 22.87\ kN$$

$$tg(\alpha) = \frac{N}{F_f} = \frac{20}{11.1} = 1.8$$

c) 8p

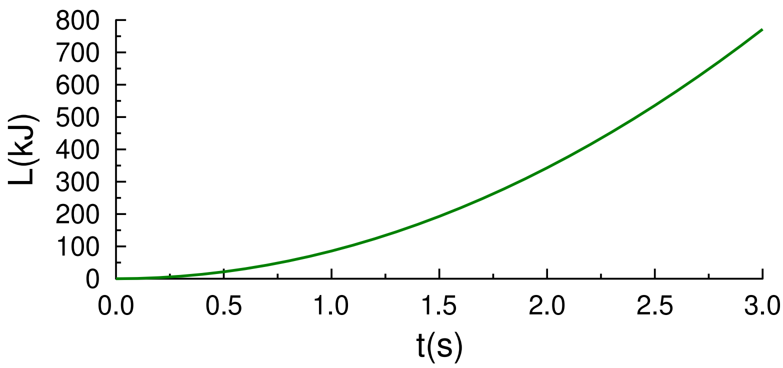
$$a_1 = \frac{v_{max}}{\Delta t_1} = \frac{100}{3}\frac{1000}{3600}\frac{m}{s^2} = 9.26\frac{m}{s^2}$$

$$L_I = E_c = \frac{mv_{max}^2}{2} = 10^3 \cdot 100^2\left(\frac{1000}{3600}\right)^2 J = 771.6\ kJ$$

$$L_1 = ma_1\Delta x_1 = ma_1\frac{a_1\Delta t_1^2}{2} = \frac{c(a_1\Delta t_1)^2}{2} = \frac{mv_{max}^2}{2}$$

d) 8p

$$L(t) = ma_1 \cdot \Delta x(t) = ma_1\tfrac{a_1t^2}{2} = \tfrac{ma_1^2}{2}t^2 = 85.73 \cdot t^2\ kJ$$



e) 7p

$$a_{max} \geq a_1 = 9.26\frac{m}{s^2}$$

$a_3 = 5.5\frac{m}{s^2} < a_{max} \Rightarrow$ mașina poate să oprească și pe o distanță mai scurtă/ Az autó egy rövidebb szakaszon belül is megállhat.

Problema 2. Feladat

a) Puntea este în echilibru pentru: / A hid egyensúlyban van ha

$\frac{R_1}{R_4} = \frac{R_2}{R_3} \Rightarrow R_4 = \frac{R_1 \cdot R_3}{R_2} = 3\ \Omega$ 2.0p

$R_e = \frac{R_1 \cdot R_4}{R_1+R_4} + \frac{R_2 \cdot R_3}{R_2+R_3} = 3.6\ \Omega$

Sau: / Vagy

$R_e = \frac{(R_1+R_2)(R_3+R_4)}{R_1+R_2+R_3+R_4} = 3.6\ \Omega$ 2.0p

$I_1 = I_2 = \frac{E}{R_1+R_2} = \frac{5}{3}\ A = 1.66\ A$ 1.5p

$I_3 = I_4 = \frac{E}{R_3+R_4} = \frac{10}{9}\ A = 1.11\ A$ 1.5p

$I = I_1 + I_4 = \frac{E}{R_e} = 2.77\ A$ 1.0p

Curentul prin voltmetru este nul la toate subpunctele pentru ca avem un voltmetru ideal, deci rezistență infinită: Az összes alpont esetén a voltmérőn áthaladó áram erössége nulla, mivel a voltmérő ideális, azaz a belső ellenállása végtelen:

$I_V = 0\ A$ 1.0p

$U_{AB} = 0\ V$ 1.0p

b) Puntea nu este în echilibru / A hid nincs egyensúlyban

$R_e = \frac{(R_1+R_3)(R_2+R_4)}{R_1+R_2+R_3+R_4} = 3.73\ \Omega$ 2.5p

$I_1 = I_3 = \frac{E}{R_1+R_3} = \frac{5}{4}\ A = 1.25\ A$ 1.5p

$I_2 = I_4 = \frac{E}{R_2+R_4} = \frac{10}{7}\ A = 1.43\ A$ 1.5p

$I = I_1 + I_4 = \frac{E}{R_e} = 2.68\ A$ 1.5p

$I_V = 0\ A$ 0.5p

$U_{AB} = U_B - U_A = I_1 \cdot R_1 - I_4 \cdot R_4 = \frac{-25}{14}\ V = -1.78\ V$ 2.5p

c)

$R_e = R_1 + \frac{R_2 \cdot R_3}{R_2+R_3} = 4.4\ \Omega$ 2.5p

$I = I_1 = \frac{E}{R_e} = 2.27\ A$ 1.5p

$I_2 = \frac{E - I_1 \cdot R_1}{R_2} = 1.36\ A$ 1.5p

$I_3 = \frac{E - I_1 \cdot R_1}{R_3} = I_1 - I_2 = 0.91\ A$ 1.5p

$I_V = 0\ A$ 0.5p

$U_V = I_1 \cdot R_1 = 4.55\ V$ 2.5p

d)

$R_e = R_1 + R_3 = 8\ \Omega$ 3.0p

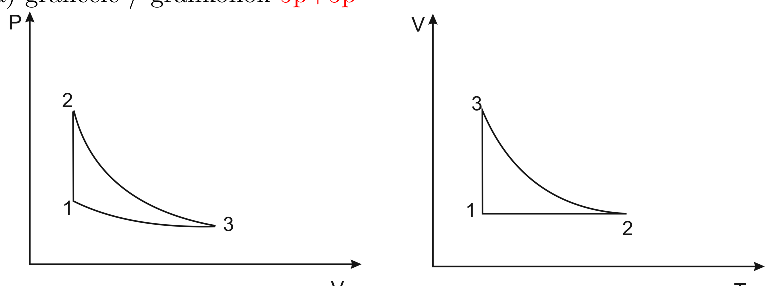
$I = I_1 = I_3 = \frac{E}{R_e} = \frac{5}{4}\ A = 1.25\ A$ 3.0p

$I_V = 0\ A$ 1.0p

$U = I_1 \cdot R_1 = 2.5\ V$ 3.0p

Problema 3. Feladat

a) graficele / grafikonok 5p+5p



(a) (b)

b)(9p) Transformare 1-2 este izocoră / Az 1-2 folyamat izochor $V_1 = V_2$

$$\frac{P_1}{T_1} = \frac{P_2}{T_2} \Rightarrow \frac{T_2}{T_1} = \frac{P_2}{P_1} = \frac{T_2}{T_3} \quad (1)$$

Transformarea 2-3 este adiabatică / a 2-3 folyamat adiabatikus

$$P_2V_1^\gamma = P_3V_3^\gamma; \quad T_2V_2^{\gamma-1} = T_3V_3^{\gamma-1} \tag{2}$$

Transformarea 3-1 este izotermă / A 3-1 folyamat izoterm $T_3 = T_1$

$$P_3V_3 = P_1V_1 \Rightarrow V_1 = \frac{P_3V_3}{P_1} \Rightarrow V_2 = \frac{P_3V_3}{P_1} \tag{3}$$

Înlocuim (3) în (2) / A (3)-ast a (2)-be helyettesítve

$$P_2\left(\frac{P_3V_3}{P_1}\right)^\gamma = P_3V_3^\gamma \Rightarrow P_2 = \frac{P_3V_3^\gamma}{\left(\frac{P_3V_3}{P_1}\right)^\gamma} = P_3^{1-\gamma}P_1^\gamma \tag{4}$$

Mai avem din (2) / A (2) alapján

$$T_2V_2^{\gamma-1} = T_3V_3^{\gamma-1} \Rightarrow \frac{T_2}{T_3} = \left(\frac{V_3}{V_2}\right)^{\gamma-1} = \epsilon^{\gamma-1} \Rightarrow T_2 = T_3\epsilon^{\gamma-1} \Longleftrightarrow T_2 = T_1\epsilon^{\gamma-1} \tag{5}$$

c)(8p) În destinderea adiabată / Adiabatikus összenyomás során:

$$Q_{23} = 0 \Rightarrow L_{23} = -\Delta U_{23} = -\nu C_v\left(T_3 - T_2\right)$$

$$\left.\begin{array}{l} L_{23} = \nu C_V T_3\left(\frac{T_2}{T_3} - 1\right) \\ T_2 = T_3\epsilon^{\gamma-1} \\ P_3V_3 = \nu RT_3 \\ R = C_P - C_V \end{array}\right\} \Rightarrow L_{23} = \frac{\nu C_V P_3V_3}{\nu R}\left(\epsilon^{\gamma-1} - 1\right) = \frac{C_V P_3V_3}{C_V\left(\frac{C_P}{C_V} - 1\right)}\left(\epsilon^{\gamma-1} - 1\right)$$

$$\left.\begin{array}{r} L_{23} = \frac{P_3V_3}{\gamma-1}\left(\epsilon^{\gamma-1} - 1\right) \\ \epsilon = \frac{V_3}{V_1} \\ V_1 = \frac{P_3V_3}{P_1} \end{array}\right\} \Rightarrow L_{23} = \frac{P_3V_3}{\gamma - 1}\left[\left(\frac{V_3}{\frac{P_3V_3}{P_1}}\right)^{\gamma-1} - 1\right] = \frac{P_3V_3}{\gamma - 1}\left[\left(\frac{P_1}{P_3}\right)^{\gamma-1} - 1\right]$$

d) (5p) În destinderea adiabată / Adiabatikus összenyomás során $Q_{23} = 0 \Rightarrow \Delta U_{23} = -L_{23}$

$$U_{23} = -L_{23} = \frac{-P_3V_3}{\gamma - 1}\left[\left(\frac{P_1}{P_3}\right)^{\gamma-1} - 1\right]$$

e) 8p

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

$$\eta = 1 - \frac{(\gamma - 1)\ln\epsilon}{\epsilon^{\gamma-1} - 1}$$

Problema 4. Feladat

a) 8p

$$p_1 = -20\ cm; \quad p_2 = 30\ cm$$

$$\frac{1}{f} = \frac{-1}{p_1} + \frac{1}{p_2} \Rightarrow f = \frac{p_1 - p_2}{p_1p_2} \Rightarrow f = 12\ cm$$

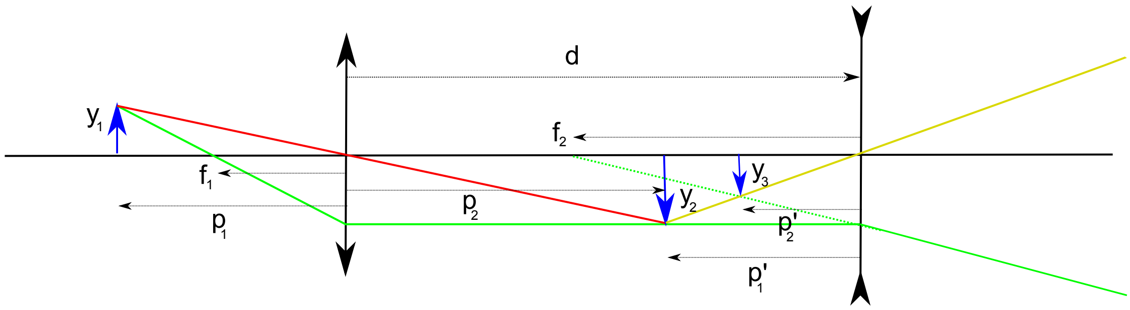
b) 8p

$$\frac{1}{f} = (n-1)\frac{1}{R} \Rightarrow R = (n-1)f \Rightarrow R = 6\ cm$$

c) 10p

$$p_1' = -20\ cm;\ p_2' = 80\ cm;\ F = \frac{p_1' - p_2'}{p_1'p_2'} \Rightarrow F = 16\ cm$$

$$C = C_1 + C_2 \Rightarrow \frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2} \Rightarrow f_2 = \frac{f_1F}{f_1 - F}$$



$$f_1 = 12\ cm;\ \ F = 16\ cm; \Rightarrow f_2 = -48\ cm$$

d)

$$p_1 = -20\ cm;\ \ p_2 = 30\ cm;$$

$$\frac{y_2}{y_1} = \frac{p_2}{p_1} \Rightarrow y_2 = \frac{p_2 y_1}{p_1} = \frac{-3}{2} y_1$$

Dacă imaginea finală este răsturnată/ fordított állású végső kép esetén

$$y_3 = -y_1 \Rightarrow \frac{y_3}{y_2} = \frac{-y_1}{\frac{-3}{2} y_1} = \frac{2}{3} = \frac{p_2'}{p_1'} \Rightarrow p_2' = \frac{2}{3} p_1'$$

$$\frac{1}{p_2'} - \frac{1}{p_1'} = \frac{1}{f_2} \Rightarrow \frac{3}{2p_1'} - \frac{1}{p_1'} = \frac{1}{f_2} \Rightarrow \frac{1}{2p_1'} = \frac{1}{f_2} \Rightarrow p_1' = \frac{f_2}{2} = -24\ cm$$

$$d = p_2 - p_1' = 30\ cm + 24\ cm = 54\ cm \quad 10p$$

Dacă imaginea finală este dreaptă/ egyenes állású kép esetén

$$y_3 = y_1 \Rightarrow \frac{y_3}{y_2} = \frac{y_1}{\frac{-3}{2} y_1} = \frac{-2}{3} = \frac{p_2'}{p_1'} \Rightarrow p_2' = \frac{-2}{3} p_1'$$

$$\frac{1}{p_2'} - \frac{1}{p_1'} = \frac{1}{f_2} \Rightarrow \frac{-3}{2p_1'} - \frac{1}{p_1'} = \frac{1}{f_2} \Rightarrow \frac{-5}{2p_1'} = \frac{1}{f_2} \Rightarrow p_1' = \frac{-5 f_2}{2} = 120\ cm$$

$$d = p_2 - p_1' = 30\ cm - 120\ cm = -90\ cm$$

$d < 0$ este în contradicție cu aranjamentul asumată a lentilelor / $d < 0$ ellentmond a feltételezett lencseelrendezésnek.4p