Bprof 8. gyakorlat

#1.

$n = 2\ mol$

$p_1 = 10^5\ Pa$

$T_1 = 273\ K$

$Q = 6800\ J$

$V = áll.$; $f = 3$

a) I. főtétel: $\Delta E = Q + W$

$Q = \Delta E + W_{kül}$, $W_{kül} = 0$, mert $\Delta V = 0$.

tehát: $Q = \frac{f}{2} nR(T_2 - T_1) \rightarrow T_2 = T_1 + \frac{2Q}{fnR} \approx$

$\approx 546\ K\ (= 2T_1)$

b) $\frac{p_1}{T_1} = \frac{p_2}{T_2} \rightarrow p_2 = p_1 \cdot \frac{T_2}{T_1} = 2p_1 = 2 \cdot 10^5\ Pa$

c) $C_V = \frac{f}{2} R = \frac{3}{2} R = 12{,}5\ \frac{J}{K \cdot mol}$

#2.

$m = 8{,}00\ kg$

$A = 5{,}00\ cm^2$

$n = 0{,}200\ mol$

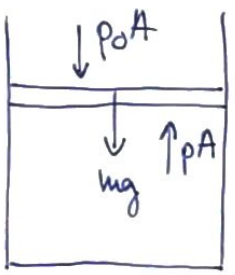
$T_1 = 20°C = 293\ K$

$T_2 = 300°C = 573\ K$

$p_0 = 10^5\ Pa$

$p = áll.$

a)



dugattyú egyensúlya miatt:

$pA = mg + p_0A$

$p = p_0 + \frac{mg}{A} =$

$= 2{,}6 \cdot 10^5\ Pa$

b) $f = 3$

$\Delta E = \frac{f}{2} nR(T_2 - T_1) \approx 700\ J$

c) $W_{gáz} = p \cdot \Delta V = -W_{kül}$ és $p \cdot \Delta V = nR\Delta T \rightarrow W_{gáz} = nR(T_2 - T_1) =$

$\approx 465\ J$

$W_{kül} = -465\ J$

d) A gáz megnöveli a dugattyú és a külső levegő helyzeti energiáját:

$$\Delta V = \frac{nR\Delta T}{p} = 1{,}8 \cdot 10^{-3}\ m^3 \rightarrow \Delta h = \frac{\Delta V}{A} = 3{,}6\ m$$

$$W_1 = mg \cdot \Delta h \approx 285\ J$$
$$W_2 = p_0 \cdot A \cdot \Delta h = p_0 \Delta V \approx 180\ J$$
$$\Big\} \; W_1 + W_2 = W_{gáz}$$

e) $$Q = \frac{f}{2} p \cdot \Delta V + p \cdot \Delta V = \frac{f+2}{2} p \Delta V = \frac{f+2}{2} nR\Delta T = \Delta E + W_{gáz} \approx 1170\ J$$

f) $$C_p = \frac{f+2}{2} R = 20{,}8\ \frac{J}{K \cdot mol}$$

(F3.)

$n = 1\ mol$ $\quad T = áll.$

$W_{tág} = 3000\ J$

$V_2 = 25{,}0\ \ell$

$p_2 = 10^5\ Pa\ (\hat{=} 1\ atm)$

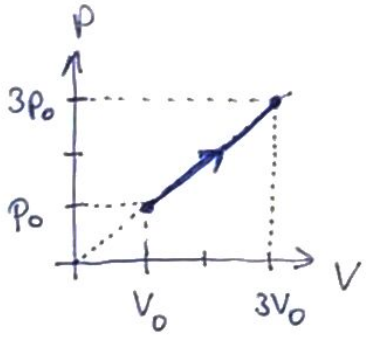
a) $$p_2 V_2 = nRT \rightarrow$$
$$\rightarrow T = \frac{p_2 V_2}{nR} \approx 300\ K$$

b) $$Q = \underbrace{\Delta E}_{=0} + W_{tág} = W_{tág} = 3000\ J$$

c) $$W_{tág} = nRT \ln \frac{V_2}{V_1} \rightarrow \ln \frac{V_2}{V_1} = \frac{W_{tág}}{nRT} = 1{,}2 \rightarrow$$

$$\rightarrow V_1 = \frac{V_2}{e^{1{,}2}} = 7{,}5\ \ell$$

(F4.)



a) $$\frac{p_0 V_0}{T_0} = \frac{3p_0 \cdot 3V_0}{T} \rightarrow T = 9T_0$$

b) $$\Delta E = \frac{5}{2}\left(3p_0 \cdot 3V_0 - p_0 V_0\right) = 20 p_0 V_0$$

c) $$W_{kül} = -W_{tág} = -\frac{p_0 + 3p_0}{2}\left(3V_0 - V_0\right) = -4 p_0 V_0$$

$W_{tág}$: p-V görbe alatti terület

d) $$Q = \Delta E + W_{tág} = 24 p_0 V_0$$

e) Bizonyos térfogatig:

$$Q = \frac{5}{2}\left(pV - p_0 V_0\right) + \frac{p + p_0}{2}\left(V - V_0\right)$$

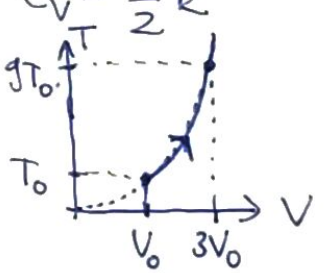
$\frac{p}{V} = \frac{p_0}{V_0}$ (origóból kiinduló félegyenes)

Ezzel: $$Q = \frac{5}{2}\left(pV - p_0 V_0\right) + \frac{1}{2}\left(pV \underbrace{- pV_0 + p_0 V}_{=0} - p_0 V_0\right) =$$

$$= 3\left(pV - p_0 V_0\right) = 3nR\left(T - T_0\right) \Rightarrow C = 3R = \text{áll.}$$

$$C_p = \frac{7}{2}R \; ; \; C_V = \frac{5}{2}R$$

f) $$\left.\begin{aligned} p &= \text{áll.} \cdot V \\ p &= \frac{nRT}{V} \end{aligned}\right\} \quad T = \frac{\text{áll.}}{nR} \cdot V^2 \text{ (parabola)}$$



$$\left.\begin{aligned} p &= \text{áll.} \cdot V \\ V &= \frac{nRT}{p} \end{aligned}\right\} \quad p = \sqrt{\text{áll.} \cdot nR} \cdot \sqrt{T}$$