Izotarický děj - p = konst $dp = 0$

$dQ = dW + dA'$

$dQ = m c_v dT + p dV$

$Q = m c_v (T_2 - T_1) + p (V_2 - V_1)$ $\quad pV = nRT \Rightarrow V = \frac{nRT}{p}$

a) $Q = m c_v (T_2 - T_1) + p\left(\frac{nRT_2}{p} - \frac{nRT_1}{p}\right) = m c_v (T_2 - T_1) + nR(T_2 - T_1) =$

$= n c_v (T_2 - T_1) + nR(T_2 - T_1) = n(T_2 - T_1)(c_v + R)$

Mayerova rovnice $c_p - c_v = R \Rightarrow c_p = c_v + R$

$Q = n(T_2 - T_1) c_p = n \varkappa c_v (T_2 - T_1)$ $\quad \varkappa = \frac{c_p}{c_v}$ (473)

b) $Q = m c_v (T_2 - T_1) + p(V_2 - V_1)$ $\quad pV = nRT \Rightarrow nT = \frac{pV}{R}$

$Q = c_v \frac{p}{R}(V_2 - V_1) + p(V_2 - V_1)$ $\quad nT_2 = \frac{pV_2}{R}$

$Q = p(V_2 - V_1)\left[\frac{c_v}{R} + 1\right] = \frac{p}{R}(V_2 - V_1)(c_v + R) =$

$= \frac{p c_p}{R}(V_2 - V_1) = \frac{\varkappa c_v}{R} p(V_2 - V_1) = \frac{\varkappa c_v}{c_p - c_v} p(V_2 - V_1)$

$= \frac{\varkappa c_v}{c_v(\varkappa - 1)} p(V_2 - V_1) = \frac{\varkappa p (V_2 - V_1)}{\varkappa - 1}$ (380)

Adiabatický děj:

Q = konst $dQ = 0$ $\quad dA' = -dW$ práce plynu na úkor vnitř. energie

a) $A' = -\int_1^2 dW = W_1 - W_2 = m c_v (T_1 - T_2)$

b) $A = \int_{V_1}^{V_2} p\, dV$ $\quad pV^\varkappa = p_1 V_1^\varkappa \Rightarrow p = \frac{p_1 V_1^\varkappa}{V^\varkappa}$

$A = p_1 V_1^\varkappa \int_{V_1}^{V_2} \frac{1}{V^\varkappa} dV = p_1 V_1^\varkappa \left[\frac{V^{1-\varkappa}}{1-\varkappa}\right]_{V_1}^{V_2} = \frac{p_1 V_1^\varkappa}{1-\varkappa}\left(V_2^{1-\varkappa} - V_1^{1-\varkappa}\right)$

379; 39

1. věta termodyn. $dQ = dW + dA'$

$dQ = \nu C_v dT + p dV \qquad \nu = \frac{m}{M_m}$

$dQ = m c_v dT + p dV \qquad C_v = M_m c_v$

Izochorický děj $V = konst$

a) $dV = 0 \qquad dA' = 0$

$dQ = dW \qquad Q = \int_1^2 dW = W_2 - W_1 = m c_v (T_2 - T_1)$

Izotermický děj T konst

$dT = 0 \qquad dW = 0$

$dQ = dA'$

$Q = \int_1^2 dA' = \int_1^2 p dV =$

$p_0 V_0 = p_1 V_1$

$p_1 = \frac{p_0 V_0}{V_1}$

$= p_0 V_0 \int_1^2 \frac{1}{V} dV = p_0 V_0 \ln \frac{V_2}{V_0} = p_0 V_0 (\ln V_2 - \ln V_0)$

$= p_0 V_0 \ln \frac{1}{p_1}$

$p_0 V_0 = p_1 V_1$

$\frac{V_1}{V_0} = \frac{p_0}{p_1}$

$pV = \nu RT$

$Q = \nu RT \ln \frac{V_1}{V_0} = \nu RT \ln \frac{p_0}{p_1}$

382, 416, 417