

Prověrka "ideální_plyn_01" - řešení

R3.64 a) $t = 1\,000\text{ °C}$, $T = 1\,273\text{ K}$, b) $t = 0\text{ °C}$, $T = 273\text{ K}$, c) $t = -270\text{ °C}$, $T = 3,15\text{ K}$; $E_k = ?$

$$k = 1,38 \cdot 10^{-23}\text{ J} \cdot \text{K}^{-1}; E_k = 3kT/2; \text{ a) } E_k = 2,64 \cdot 10^{-20}\text{ J}, \text{ b) } E_k = 5,65 \cdot 10^{-21}\text{ J},$$

$$\text{c) } E_k = 6,5 \cdot 10^{-23}\text{ J}.$$

R3.65 a) O_2 : $t = 132\text{ °C}$, $T = 405\text{ K}$, $M_r = 32$; $v_k = ?$, b) He : $T = 10\text{ K}$, $A_r = 4$; $v_k = ?$

$$\text{a) } v_k = \sqrt{\frac{3kT}{m_m}} = \sqrt{\frac{3kT}{M_r m_u}} = 562\text{ m} \cdot \text{s}^{-1}$$

$$\text{b) } v_k = \sqrt{\frac{3kT}{m_a}} = \sqrt{\frac{3kT}{A_r m_u}} = 250\text{ m} \cdot \text{s}^{-1}$$

R3.66 $t_1 = 19\text{ °C}$, $T_1 = 292\text{ K}$, $v_{k2} = v_{k1}/2$; $t_2 = ?$

$$\sqrt{\frac{3kT_2}{m_m}} = \frac{1}{2} \sqrt{\frac{3kT_1}{m_m}} \Rightarrow T_2 = \frac{1}{4} T_1 = 73\text{ K}$$

$$t_2 = -200\text{ °C}$$

R3.67 CO_2 : $M_r = 44$, $v_k = 720\text{ km} \cdot \text{h}^{-1} = 200\text{ m} \cdot \text{s}^{-1}$, $m_u = 1,66 \cdot 10^{-27}\text{ kg}$; $t = ?$

$$T = \frac{v_k^2 M_r m_u}{3k} = 71\text{ K}, \quad t = -202\text{ °C}$$

R3.71 H_2 : $V = 1\text{ cm}^3 = 1 \cdot 10^{-6}\text{ m}^3$, $p = 2,6 \cdot 10^4\text{ Pa}$, $v_k = 2\,400\text{ m} \cdot \text{s}^{-1}$; $N = ?$

$$p = \frac{1}{3} N_v m_m v_k^2 = \frac{1}{3} \frac{N}{V} M_r m_u v_k^2,$$

pro H_2 je $M_r = 2$; počet molekul

$$N = \frac{3Vp}{M_r m_u v_k^2} = 4,1 \cdot 10^{18}.$$

R3.73 $V = 1\text{ cm}^3 = 1 \cdot 10^{-6}\text{ m}^3$, $t = 27\text{ °C}$, $T = 300\text{ K}$, $p = 1,2\text{ Pa}$; $N = ?$

$$p = N_v kT = \frac{N}{V} kT, \quad N = \frac{pV}{kT} = 2,9 \cdot 10^{14}$$

R3.74 $V = 2\text{ litry} = 2 \cdot 10^{-3}\text{ m}^3$, $N = 6 \cdot 10^{20}$, $p = 2,6 \cdot 10^3\text{ Pa}$; $T = ?$

$$p = N_v kT = \frac{N}{V} kT, \quad T = \frac{pV}{Nk} = 628\text{ K}, \quad t = 355\text{ °C}$$

R3.76 $p = 1 \cdot 10^5\text{ Pa}$, $\rho = 8,2\text{ kg} \cdot \text{m}^{-3}$; $v_k = ?$

$$p = \frac{1}{3} \rho v_k^2 \Rightarrow v_k = \sqrt{\frac{3p}{\rho}} = 190\text{ m} \cdot \text{s}^{-1}$$

R3.77 a) při izobarickém ději, b) při izochorickém ději, c) při izotermickém ději, d) při adiabatickém ději.

R3.78 a) diagram C, b) diagram B, c) diagram A.

R3.79 a) graf D – děj je izotermický, b) graf A – děj je izobarický, c) graf B – děj je izochorický.

R3.80 $t_1 = 18\text{ °C}$, $T_1 = 291\text{ K}$, $t_2 = -23\text{ °C}$, $T_2 = 250\text{ K}$, $p_1 = 8,5\text{ MPa}$, $V = \text{konst.}$; $p_2 = ?$

$$\frac{p_1}{T_1} = \frac{p_2}{T_2} \Rightarrow p_2 = p_1 \frac{T_2}{T_1} = 7,3\text{ MPa}$$

R3.81 $t_0 = 0\text{ °C}$, $T_0 = 273\text{ K}$, $V = 2V_0/3$; $t = ?$

$$\frac{V}{T} = \frac{V_0}{T_0}$$

$$\frac{2V_0}{3T} = \frac{V_0}{T_0} \Rightarrow T = \frac{2}{3}T_0 = 182\text{ K}$$

$$t = -91\text{ °C}$$

R3.82 $t_1 = 10\text{ °C}$, $T_1 = 283\text{ K}$, $p_1 = 75\text{ kPa}$, $t_2 = 30\text{ °C}$, $T_2 = 303\text{ K}$, $V = \text{konst.}$; $p_2 = ?$

$$\frac{p_1}{T_1} = \frac{p_2}{T_2} \Rightarrow p_2 = p_1 \frac{T_2}{T_1} = 80\text{ kPa}$$

R3.83 O_2 : $M_m = 32 \cdot 10^{-3}\text{ kg} \cdot \text{mol}^{-1}$, $m = 4\text{ kg}$, $V = 2\text{ m}^3$, $t = 27\text{ °C}$, $T = 300\text{ K}$, $R_m = 8,31\text{ J} \cdot \text{K}^{-1} \cdot \text{mol}^{-1}$; $p = ?$

$$pV = \frac{m}{M_m} R_m T \Rightarrow p = \frac{m R_m T}{V M_m} = 1,6 \cdot 10^5\text{ Pa}$$

R3.86 $V = 4V_0$, $t_0 = 0\text{ °C}$, $T_0 = 273\text{ K}$, $p = \text{konst.}$; $t = ?$

$$\frac{V}{T} = \frac{V_0}{T_0}, \frac{4V_0}{T} = \frac{V_0}{T_0} \Rightarrow T = 4T_0 = 1092\text{ K}$$

$$t = 819\text{ °C}$$

R3.87 $t_1 = 15\text{ °C}$, $T_1 = 288\text{ K}$, $p_1 = 1,5 \cdot 10^5\text{ Pa}$, $V_1 = 2\text{ l}$, $t_2 = 30\text{ °C}$, $T_2 = 303\text{ K}$, $V_2 = 1,5\text{ l}$; $p_2 = ?$

$$\frac{p_1 V_1}{T_1} = \frac{p_2 V_2}{T_2} \Rightarrow p_2 = p_1 \frac{V_1 T_2}{V_2 T_1} = 2,1 \cdot 10^5\text{ Pa}$$

R3.89 $t_1 = 27\text{ °C}$, $T_1 = 300\text{ K}$, $p_1 = 4\text{ MPa} = 4 \cdot 10^6\text{ Pa}$, $t_2 = 12\text{ °C} = 285\text{ K}$, $m_2 = m_1/2$; $p_2 = ?$

$$p_1 V = \frac{m_1}{M_m} R_m T_1$$

$$p_2 V = \frac{m_2}{M_m} R_m T_2 = \frac{m_1}{2M_m} R_m T_2$$

Dělením obou rovnic dostaneme

$$\frac{p_1}{p_2} = \frac{2T_1}{T_2} \text{ a odtud } p_2 = p_1 \frac{T_2}{2T_1} = 1,9 \cdot 10^6\text{ Pa} = 1,6\text{ MPa.}$$