

①  $A = 30 \text{ cm}$   
 $v = 30 \text{ cm s}^{-1}$   
 $f = 10 \text{ Hz}$   
 $x_1 = 20 \text{ cm}$   
 $y_1 = 15 \text{ cm}$   
 $t_1 = ?$

$$y(t) = A \sin(\omega t - kx) \quad | \quad 1b$$

$$k = \frac{2\pi}{\lambda} = \frac{2\pi f}{v} = \frac{2}{3} \pi \text{ cm}^{-1}$$

$$\omega = 2\pi f = 20\pi \text{ s}^{-1}$$

$$y_1(t_1) = A \sin(\omega t_1 - kx_1)$$

$$15 = 30 \sin\left(20\pi t_1 - \frac{40}{3}\pi\right) \quad | \quad 1b$$

$$\frac{15}{30} = \sin\left(20\pi t_1 - \frac{40}{3}\pi\right)$$

$$20\pi t_1 - \frac{40}{3}\pi = \arcsin\left(\frac{1}{2}\right)$$

$$t_1 = \frac{\arcsin\left(\frac{1}{2}\right) + \frac{40}{3}\pi}{20\pi} = 0,675 \text{ s}$$

$$\text{resp. } t_1 = \frac{\arcsin\left(\frac{1}{2}\right) + \frac{40}{3}\pi}{20\pi} = 0,683 \text{ s}$$

1b

②

 $V_1$  $P_1$  $T_1$ 

$V_2 = 2V_1$

$T_2 = T_1$

a)  $P_1 V_1 = N k_B T_1$

$P_2 V_2 = N k_B T_1$

$$\frac{P_1 V_1 = N k_B T_1}{P_2 2V_1 = N k_B T_1}$$

$$\frac{P_1 V_1}{T_1} = \frac{P_2 2V_1}{T_1}$$

$$\underline{P_2 = \frac{1}{2} P_1} \quad 1b$$

b)  $W = \int_{V_1}^{2V_1} p dV = \int_{V_1}^{2V_1} nRT_1 \frac{1}{V} dV$

$pV = nRT_1$

$p = nRT_1 \frac{1}{V}$

$W = nRT_1 \int_{V_1}^{2V_1} \frac{1}{V} dV$

$$W = nRT_1 \ln\left(\frac{2V_1}{V_1}\right) = \underbrace{nRT_1}_{P_1 V_1} \ln(2) = \underline{P_1 V_1 \ln(2)} \quad 1b$$

c)  $\Delta Q = \Delta U + W$

"∅" ... izotermický děj

$$\underline{\Delta Q = W = P_1 V_1 \ln(2)} \quad 1b$$

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$$p_1 = 0,07 \text{ MPa}$$

$$p_2 = 0,2 \text{ MPa}$$

$$p_3 = 0,13 \text{ MPa}$$

$$M_1 = 2 \text{ g mol}^{-1}$$

$$M_2 = 16 \text{ g mol}^{-1}$$

$$M_3 = 28 \text{ g mol}^{-1}$$

$$p_1 V = \frac{m_1}{M_1} R T$$

$$p_2 V = \frac{m_2}{M_2} R T \quad 1b$$

$$p_3 V = \frac{m_3}{M_3} R T$$

$$\frac{p_1}{p_2} = \frac{m_1}{m_2} \cdot \frac{M_2}{M_1} \Rightarrow m_2 = \frac{p_2 M_2 m_1}{p_1 M_1} \quad 1b$$

$$\frac{p_1}{p_3} = \frac{m_1}{m_3} \cdot \frac{M_3}{M_1} \Rightarrow m_3 = \frac{p_3 M_3 m_1}{p_1 M_1}$$

$$m_1 + m_2 + m_3 = 1 \text{ kg} \quad 1b \Rightarrow 100\%$$

$$m_1 = \frac{1}{\frac{p_2 M_2}{p_1 M_1} + \frac{p_3 M_3}{p_1 M_1} + 1} = 0,02 \text{ kg} \Rightarrow 2\% \text{ H}_2$$

$$m_2 = \frac{p_2 M_2 m_1}{p_1 M_1} = 0,46 \text{ kg} \Rightarrow 46\% \text{ CH}_4 \quad 1b$$

$$m_3 = \frac{p_3 M_3 m_1}{p_1 M_1} = 0,52 \text{ kg} \Rightarrow 52\% \text{ CO}$$