

$$\nu = 2; R = 8,31 \frac{\text{Дж}}{\text{К}}$$

$$T_1 = 200 \text{ К}; V_1 = 0,040 \text{ м}^3; p_1 = \frac{\nu R T_1}{V_1} = \frac{2 * 8,31 * 200}{0,040} \text{ Па} = 83100 \text{ Па} = 83,1 \text{ кПа}$$

$$T_2 = 300 \text{ К}; V_2; p_2 = \frac{\nu R T_2}{V_2}$$

$$T_3 = T_2 = 300 \text{ К}; V_3 = V_1 = 0,040 \text{ м}^3; p_3 = \frac{\nu R T_3}{V_3} = \frac{2 * 8,31 * 300}{0,040} \text{ Па} = 124650 \text{ Па} = 124,65 \text{ кПа}$$

$$1 \rightarrow 2$$

$$\frac{V - V_1}{T - T_1} = \frac{V_2 - V_1}{T_2 - T_1}; T - T_1 = (T_2 - T_1) \frac{V - V_1}{V_2 - V_1}; T = T_1 + (T_2 - T_1) \frac{V - V_1}{V_2 - V_1};$$

$$\frac{pV}{T} = \frac{pV}{T_1 + (T_2 - T_1) \frac{V - V_1}{V_2 - V_1}} = \nu R$$

$$p(V) = \left(T_1 + (T_2 - T_1) \frac{V - V_1}{V_2 - V_1} \right) \frac{\nu R}{V} = \left((T_2 - T_1) \frac{V}{V_2 - V_1} \right) \frac{\nu R}{V} + \left(T_1 - (T_2 - T_1) \frac{V_1}{V_2 - V_1} \right) \frac{\nu R}{V} = \nu R \frac{T_2 - T_1}{V_2 - V_1} + \nu R \left(\frac{T_1 V_2 - T_1 V_1 - T_2 V_1 + T_1 V_1}{V_2 - V_1} \right) \frac{1}{V}$$

$$= \nu R \frac{T_2 - T_1}{V_2 - V_1} + \nu R \left(\frac{T_1 V_2 - T_2 V_1}{V_2 - V_1} \right) \frac{1}{V}$$

$$A_{1 \rightarrow 2} = \int_{V_1}^{V_2} p dV = \nu R \frac{T_2 - T_1}{V_2 - V_1} * (V_2 - V_1) + \nu R \left(\frac{T_1 V_2 - T_2 V_1}{V_2 - V_1} \right) \ln \left(\frac{V_2}{V_1} \right) = \nu R * (T_2 - T_1) + \nu R \left(\frac{T_1 V_2 - T_2 V_1}{V_2 - V_1} \right) \ln \left(\frac{V_2}{V_1} \right)$$

$$2 \rightarrow 3$$

$$\frac{pV}{T} = \nu R; p = \frac{\nu R T}{V} = \frac{\nu R T_2}{V};$$

$$A_{2 \rightarrow 3} = \int_{V_2}^{V_3} p dV = \nu R T_2 * \ln \left(\frac{V_3}{V_2} \right) = -\nu R T_2 * \ln \left(\frac{V_2}{V_1} \right)$$

$$3 \rightarrow 1$$

$$V = \text{const} = V_1$$

$$A_{3 \rightarrow 1} = 0$$

$$1 \rightarrow 2 \rightarrow 3 \rightarrow 1$$

$$A = A_{1 \rightarrow 2} + A_{2 \rightarrow 3} + A_{3 \rightarrow 1} = \nu R * (T_2 - T_1) + \nu R \left(\frac{T_1 V_2 - T_2 V_1}{V_2 - V_1} \right) \ln \left(\frac{V_2}{V_1} \right) - \nu R T_2 * \ln \left(\frac{V_2}{V_1} \right) = \nu R * (T_2 - T_1) + \nu R \left(\frac{T_1 V_2 - T_2 V_1 - T_2 V_2 + T_2 V_1}{V_2 - V_1} \right) \ln \left(\frac{V_2}{V_1} \right)$$

$$= \nu R * (T_2 - T_1) + \nu R V_2 \left(\frac{T_1 - T_2}{V_2 - V_1} \right) \ln \left(\frac{V_2}{V_1} \right) = \nu R * (T_2 - T_1) \left(1 - \frac{V_2}{V_2 - V_1} \ln \left(\frac{V_2}{V_1} \right) \right) \leq \nu R * (T_2 - T_1) = 2 * 8,31 * (300 - 200) \text{ Дж} = 1662 \text{ Дж}$$

$$A \leq 1662 \text{ Дж}$$