Задача №1

Идеальный газ.

$$A = \int_{V_3}^{V_1} p\ dV - p(V_1 - V_2) = \nu R T_1 \ln \frac{V_1}{V_3} - p(V_1 - V_2) = \nu R T_1 \ln 2 - \frac{1}{2} p V_1 = \nu R T_1\ (\ln 2 - \frac{1}{2})$$

Газ Ван-дер-Ваальса.

$$A = \int_{V_3}^{V_1} p\ dV - p_1(V_1 - V_2) = \nu R T_1 \ln \frac{V_1 - b}{V_3 - b} + a\nu^2 \left(\frac{1}{V_1} - \frac{1}{V_3}\right) - \frac{1}{2} p_1 V_1 = \nu R T_1 \ln \frac{V_1 - b}{\frac{1}{2}V_1 - b} - \frac{a\nu^2}{V_1} - \frac{1}{2} p_1 V_1$$

Задача №3

$$\delta Q = dU + pdV \quad \Longrightarrow \quad \frac{\delta Q}{dV} = \frac{\partial U}{\partial V} + p$$

$$\eta = \frac{\Delta T}{T} = \frac{A}{Q}$$

$$Q = A\frac{T}{\Delta T} \quad \Longrightarrow \quad \delta Q = T\ \frac{\delta A}{dT}$$

$$\frac{\delta Q}{dV} = T\frac{\partial}{\partial T}\left(\frac{\delta A}{dV}\right) = T\left(\frac{\partial p}{\partial T}\right)$$

$$T\left(\frac{\partial p}{\partial T}\right) = \frac{\partial U}{\partial V} + p$$

Задача №4

$$Q = Q_{12} + Q_{23} + Q_{31} = c_v(T_3 - T_1) - c_p(T_3 - T_1) + RT_3 \ln \frac{V_3}{V_1}$$

$$Q = A = RT_3 \ln \frac{V_3}{V_1} + p_1(V_1 - V_3)$$

$$(c_v - c_p)(T_3 - T_1) = p_1(V_1 - V_3) = -R(T_3 - T_1)$$

$$c_p - c_v = R$$