All processes below are for ideal gas.

1 Isothermal process

$$P\nu = RT$$
$$P = RT/\nu$$

2 Isobaric process

$$P\nu = RT$$
$$\nu = RT/P$$

3 Isentropic ideal gas

3.1 Adiabatic + reversible = isentropic

Entropy balance equation:

$$s_i - s_e + \int_1^2 \frac{\delta q}{T} + s_{\text{gen}} = 0$$

Adiabatic means $Q = 0$ and reversible means $s_{\text{gen}} = 0$. As a result,

$$s_i = s_e$$

Therefore, adiabatic and reversible process is isentropic process.

3.2 Isentropic process relations

$$\frac{T_1}{T_2} = \left(\frac{V_2}{V_1}\right)^{\gamma-1}$$

$$\frac{T_1}{T_2} = \left(\frac{P_1}{P_2}\right)^{(\gamma-1)/\gamma}$$

where, γ is the ratio of specific heats. $\gamma = 1.4$ for air.

4 Constant volume heat transfer

No work generated. Heat is converted into thermal energy.

$$q = C_\nu(T_2 - T_1)$$

where, C_ν is specific heat at constant volume. $C_\nu = 0.718\,\mathrm{kJ\,kg^{-1}\,K}$.

4.1 Temperature and entropy relation

This equations tells that finite difference in temperature results in heat transfer. Differentially,

$$\delta q = C_\nu \mathrm{d}T$$

Divide both sides by temperature T,

$$\begin{aligned} \delta q/T &= C_\nu \mathrm{d}T/T \\ \mathrm{d}s &= C_\nu \mathrm{d}T/T \end{aligned}$$

Integrate

$$s_2 - s_1 = C_\nu \ln \frac{T_2}{T_1}$$

For any s and T, taking state 1 as reference,

$$\begin{aligned} s - s_1 &= C_\nu \ln \frac{T}{T_1} \\ \exp(s - s_1) &= \left(\frac{T}{T_1}\right)^{C_\nu} \\ T^{C_\nu} &= T_1^{C_\nu} \exp(s - s_1) \\ T &= T_1 \exp(s - s_1)^{C_\nu} \end{aligned}$$