

Exercise I: Thermodynamic cycle

Data:

Consider the following ideal cycle:

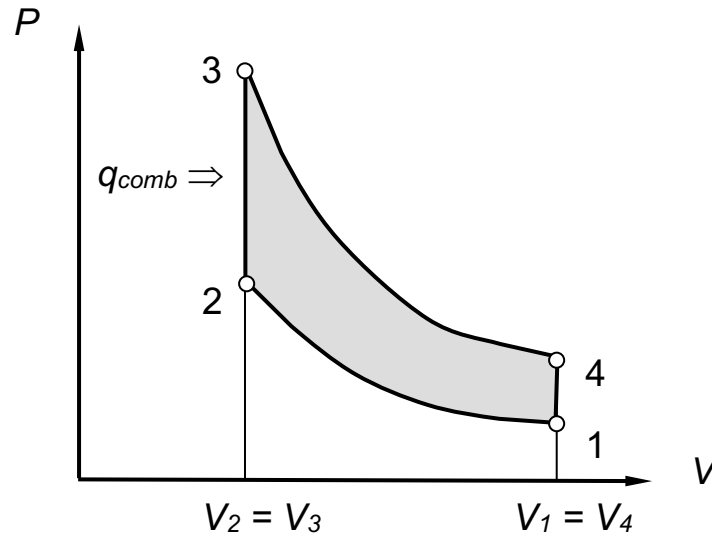


Fig 1: Constant-volume ideal cycle (OTTO cycle)

The thermodynamic conditions at state 1 are defined by: P_1, V_1, T_1

The heat input q_{comb} can be expressed as a non-dimensional parameter ξ : $\xi = \frac{q_{comb}}{c_v \cdot T_1}$

Reminder: Compression ratio is given by: $\varepsilon = \frac{V_1}{V_2}$

Questions:

- Express the thermodynamic states at 2, 3 and 4 of the above thermodynamic process as a function of the thermodynamic conditions of state 1 and the parameters ε , γ and ξ .

$$P_{2,3,4} = f(P_1, \varepsilon, \gamma, \xi) \quad ; \quad T_{2,3,4} = f(T_1, \varepsilon, \gamma, \xi) \quad ; \quad V_{2,3,4} = f(V_1, \varepsilon)$$

- From the relations obtained at question 1 and by applying the 1st Law of Thermodynamics, find again the following equation:

$$\eta = 1 - \frac{1}{\varepsilon^{\gamma-1}}$$