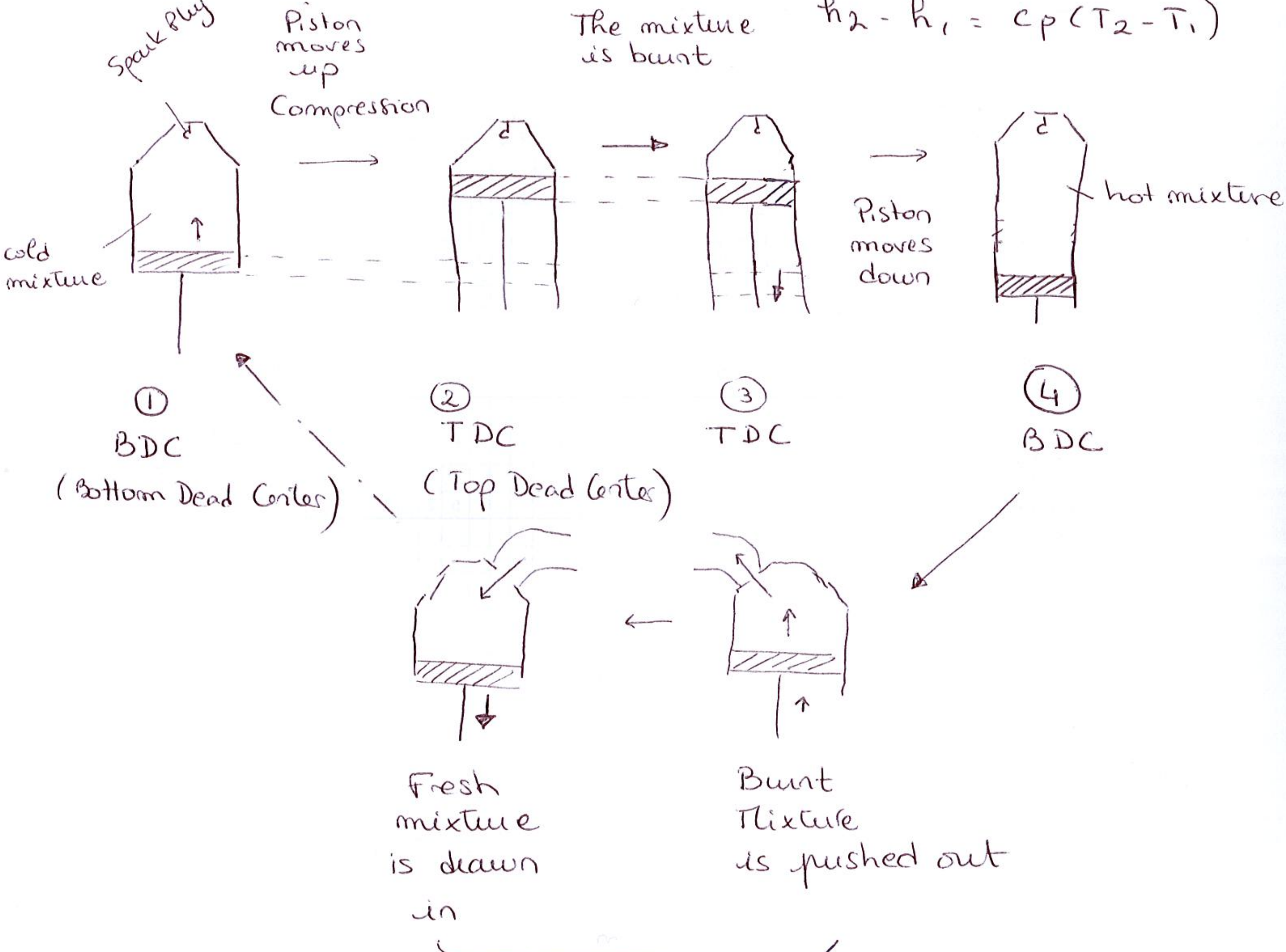
JProf Benoît FOND.

Ideal Otto Cycle

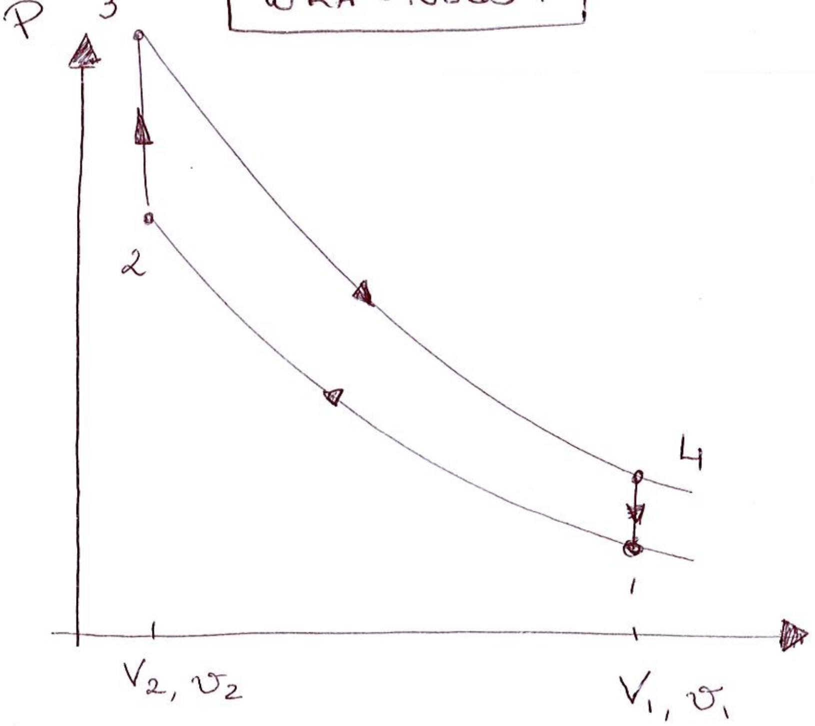
Assumptions:
- working fluid is mixture of fuel & air, with fixed thermal properties (C_p, C_v, γ)
- fluid is perfect gas.
  - ideal gas $Pv = RT$
  - constant C_p, C_v

$$u_2 - u_1 = c_v (T_2 - T_1)$$
$$h_2 - h_1 = c_p (T_2 - T_1)$$



modelled as Heat rejection at constant volume

WKA - Notes 1



$1 \to 2$ Adiabatic, reversible = isentropic compression

$2 \to 3$ Constant volume heat addition. (Instantaneous combustion)

$3 \to 4$: Isentropic expansion

$4 \to 1$: Constant volume heat rejection. (Gas exchange)

$$\boxed{\frac{V_1}{V_2} = r_v}$$ Compression ratio

$$\eta_{th} = \frac{W_{net}}{Q_{in}} = 1 - \frac{Q_{out}}{Q_{in}} = 1 - \frac{|Q_{41}|}{Q_{23}}$$

$$= 1 - \frac{|m c_v (T_1 - T_4)|}{m c_v (T_3 - T_2)}$$

$$= 1 - \frac{m c_v (T_4 - T_1)}{m c_v (T_3 - T_2)}$$

$$= 1 - \frac{(T_4 - T_1)}{(T_3 - T_2)}$$

$1 \to 2$ Isentropic
$3 \to 4$ Isentropic } $T v^{\gamma - 1} = cst$

$$\frac{T_2}{T_1} = \left(\frac{v_1}{v_2}\right)^{\gamma-1}$$

$$\frac{T_3}{T_4} = \left(\frac{v_4}{v_3}\right)^{\gamma-1} = \left(\frac{v_1}{v_2}\right)^{\gamma-1}$$

$$\frac{T_2}{T_1} = \frac{T_3}{T_4} = (r_v)^{\gamma-1}$$

WKA Notes 1

$$\eta_{th} = 1 - \frac{(T_4 - T_1)}{T_3 - T_2} = 1 - \left(\frac{T_1}{T_2}\right)\left(\frac{\frac{T_4}{T_1} - 1}{\frac{T_3}{T_2} - 1}\right)$$

$$\frac{T_2}{T_1} = \frac{T_3}{T_4} \rightarrow \frac{T_4}{T_1} = \frac{T_3}{T_2}$$

$$\boxed{\eta_{th} = 1 - \frac{1}{r_v^{\gamma - 1}}}$$

$r_v \nearrow \Rightarrow \eta_{th} \nearrow$