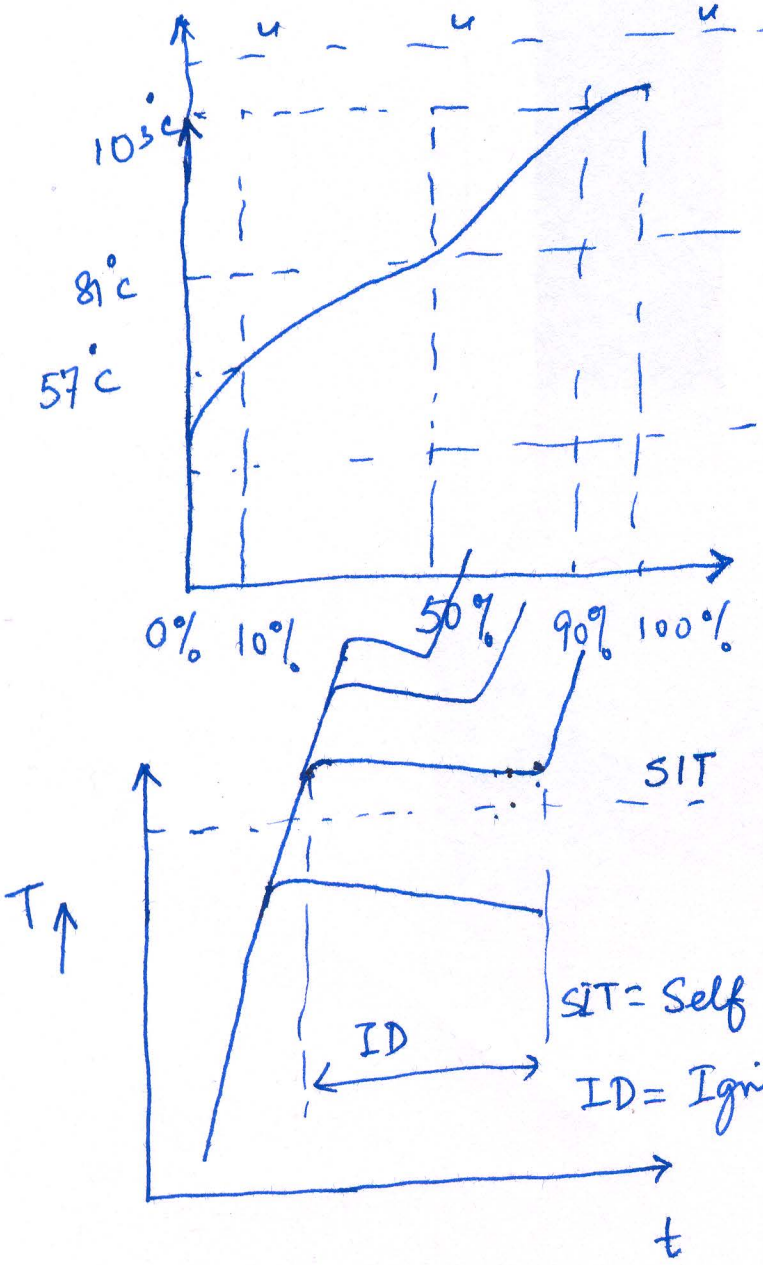
$$\text{Volumetric effy} = \frac{\dot{m}_a}{\rho_a V_d \times \frac{N}{60} \times \frac{1}{2}}$$

$\dot{m}_a$ air + fuel vapour well mixed

some amount of fuel evaporated

" " should get evaporated

" " be in liquid



57 - 81 - 103

SIT = Self ignition temperature

ID = Ignition delay

$$\frac{T_2}{T_1} = \left(\frac{V_1}{V_2}\right)^{\gamma-1} = 8^{1.35-1} = 2.07$$

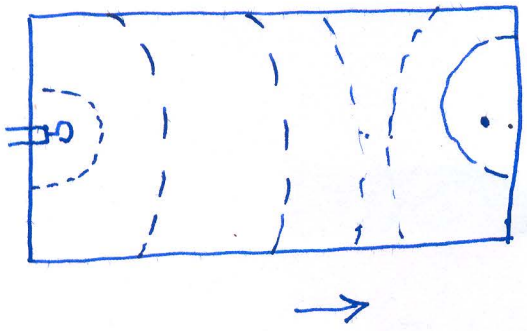
$T_1 = 60 + 273 = 333$

$T_2 = 689\ K$

$$\frac{T_2}{T_1} = \left(\frac{V_1}{V_2}\right)^{\gamma-1} = 18^{1.35-1} = 2.75$$

$T_2 = 916\ K$

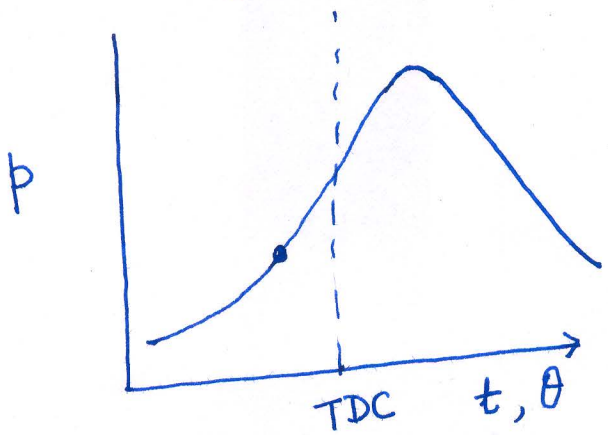
$$\frac{A}{V} \sim \frac{4\pi r^2}{\frac{4}{3}\pi r^3} \sim \frac{1}{r}$$



Flame front

temperature > SIT

Knocking → SI detonation → CI



A four cylinder SI engine with a compression ratio $r_c = 10$ operates on an air-standard Otto cycle at 3000 RPM using ethyl alcohol as fuel. At the start of the compression, temperature and pressure are 60°c and 101 kPa. Combustion efficiency $\eta_c = 97\%$. Write the balanced stoichiometric chemical equation for this fuel. $Q_{HV} = 26950$ KJ/kg.

Calculate:

(a) AF if $\varphi = 1.1$ 8.18

(b) Peak temperature [°C] 4218 K 3945°C

(c) Peak pressure. [kPa] 12777 kPa.

C_2H_5OH

$$C_2H_5OH + 3(O_2 + 3.76N_2) \rightarrow 2CO_2 + 3H_2O + 11.28N_2$$

$$(AF)_{Stoich} = \frac{3 \times 4.76 \times 28.97}{2\times12 + 6\times1 + 16} = 9$$

$$(AF)_{act} = \frac{(AF)_{stoich}}{\varphi} = \frac{9}{1.1} = 8.18$$

$$\frac{T_2}{T_1} = \left(\frac{v_1}{v_2}\right)^{\gamma-1} = (r_c)^{1.35-1} = 10^{0.35} = 2.24$$

$$T_1 = 273 + 60 = 333$$

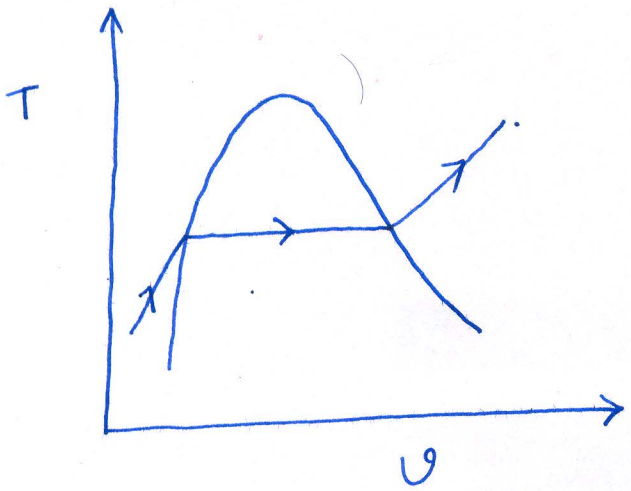
$$T_2 = 746\ K$$

$$C_v = \frac{R}{\gamma - 1} = \frac{0.287}{0.35} = 0.82$$

$$m_f \times Q_{HV} \times \eta_c = (m_a + m_f) C_v (T_3 - T_2)$$

$$Q_{HV} \times \eta_c = (AF + 1) C_v (T_3 - T_2) \qquad T_3 =$$

$$\frac{P_2}{P_1} = \left(\frac{v_1}{v_2}\right)^{\gamma}$$



Air $\frac{Pv}{P_{atm.}}$