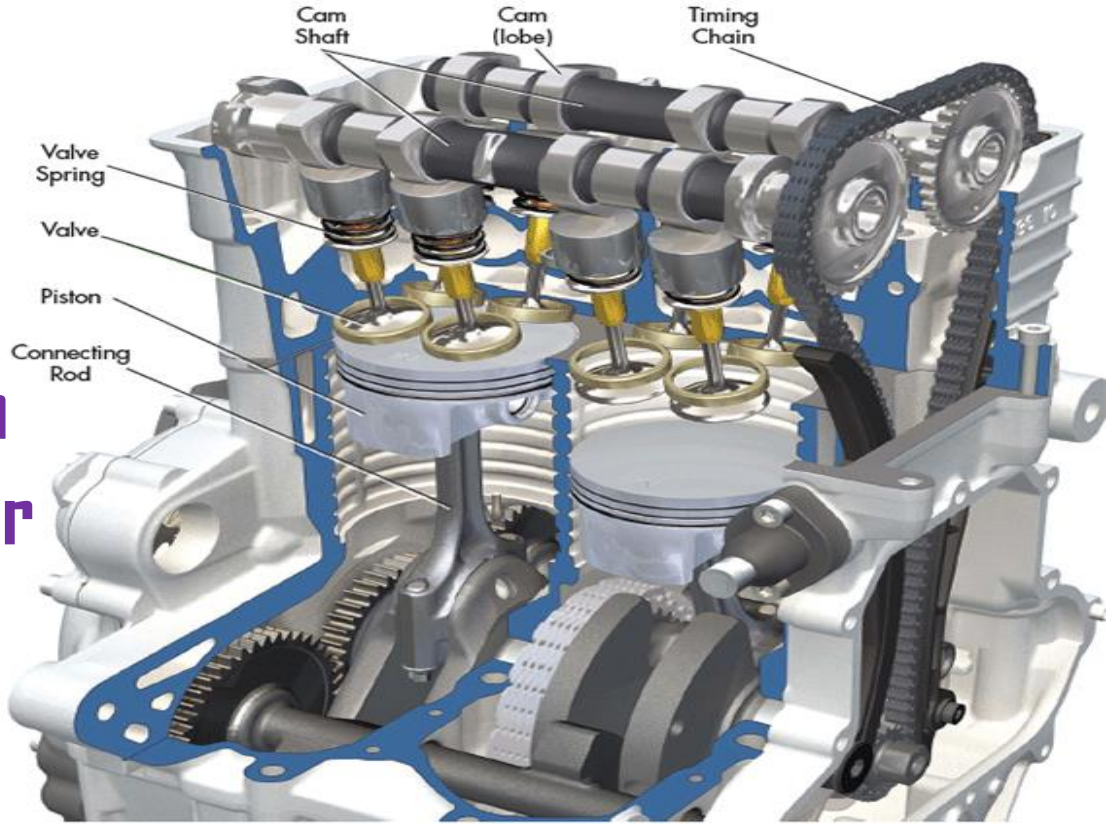
# I C Engine, Steam & Nuclear Power

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# Compression ratio

$$r = \frac{V_1}{V_2} = \frac{V_c + V_s}{V_c}$$

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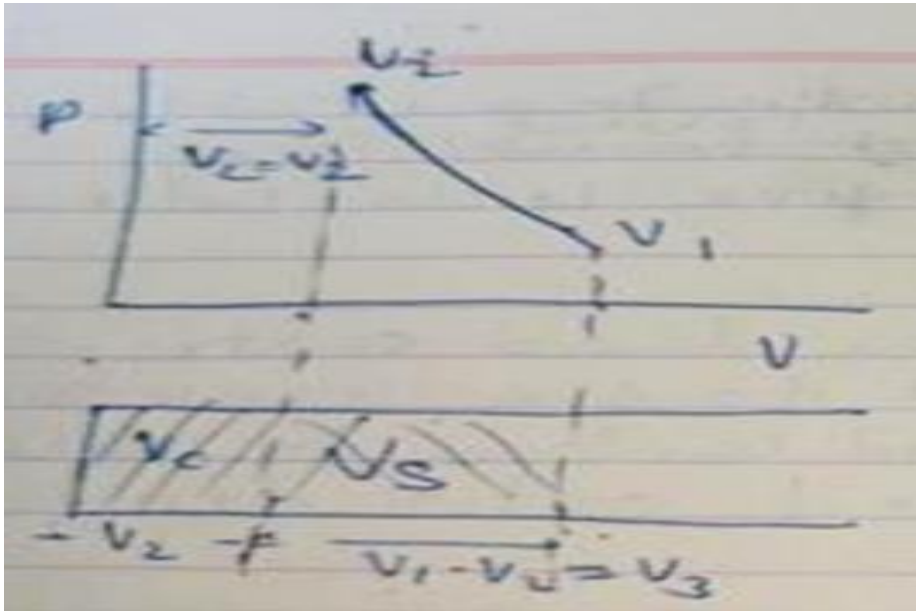


$V_c$ = clearance volume.

$V_s$= stroke volume

r = compression ratio

# Thermal efficiency of Otto Cycle

$$\eta_{otto} = \frac{W_{net}}{q_s} = \frac{q_s - q_R}{q_s}$$

Heat supplied, $q_s = C_v(T_3 - T_2)$

Heat rejection, $q_R = C_v(T_4 - T_1)$

Compression ratio, $r = \frac{V_1}{V_2}$

Thermal efficiency, $\eta = \frac{q_s - q_R}{q_s} = \frac{Cv(T3-T2) - Cv(T4-T1)}{Cv(T3-T2)} = 1 - \frac{T4-T1}{T3-T2}$

In process 1-2, adiabatic compression process,

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

$$T_2 = T_1.(r\ )^{\gamma-1}$$

In adiabatic expansion process, 3-4,

$$\frac{T_4}{T_3} = \left(\frac{V_3}{V_4}\right)^{\gamma-1} = \left(\frac{V_2}{V_1}\right)^{\gamma-1}$$

$$T_3 = T_4.(r\ )^{\gamma-1}$$

$$\eta = 1 - \frac{T_4 - T_1}{T_4.(r\ )^{\gamma-1} - T_1.(r\ )^{\gamma-1}}$$

$$= 1 - \frac{1}{(r\ )^{\gamma-1}}$$

$$\eta = 1 - \frac{1}{(r)^{(\gamma-1)}}$$

# 4-strokr CI engine

**4-S CI engine operates on higher compression ratio.**

**CI : 16 -20**

1. **Suction Stroke -** In this stroke the piston is moves from top dead center (TDC) to bottom dead center (BDC). Fresh Air comes into cylinder during this stroke.
2. **Compression Stroke** - In this stroke the piston is moves from bottom dead center (BDC) to top dead center (TDC). In this stroke the piston compresses the air into clearance volume. Both the intake and exhaust valves are closed during this stroke.
3. **Expansion stroke :** Also known as power stroke. Fuel injection start nearly at the end of compression stroke .Heat is added at constant pressure .After the injection of fuel is completed the products of combustion expand and both valve remain closed during this stroke. In this stroke the piston is moves from top dead center (TDC) to bottom dead center (BDC).

4. **Exhaust**: In this stroke the piston is moves from bottom dead center (BDC) to top dead center (TDC). . while the exhaust valve is open. This action expels the spent product of combustion through the exhaust valve.