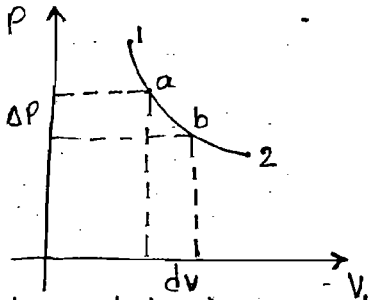
- The only difference in b/w reversible & irreversible process is Friction - loss.
- In quasi-static process will not be taken in irreversible process to.
- Degree of randomness means measurment of out of order. (for entropy).

Quasistatic process :-

⇒ Quasi → partly (or) rest
or. differential calculus are same meaning.

$$W = \int dW = \int_1^2 P\,dV$$

$$W = P(V_2 - V_1)$$



Quasi-static process is not used for irreversible process.
- It should be taken when the value is constant & it change the value.

- Table showing the various expression For the different thermodynamic process undergone by a system :-
  - only For ideal gas reversible process

SL NO	CONTENTS / Process	constant Volume Process	constant Pressure Process	constant Temprature Process	The Adiabatic process
1.	P, V & T relations	$\frac{P_2}{P_1} = \frac{T_2}{T_1}$	$\frac{V_2}{V_1} = \frac{T_2}{T_1}$	$P_1V_1 = P_2V_2$	① $P_1V_1^\gamma = P_2V_2^\gamma$ ② $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ ③ $\left(\frac{P_2}{P_1}\right)^{\frac{\gamma-1}{\gamma}} = \frac{T_2}{T_1}$ ④ $\left(\frac{V_2}{V_1}\right)^{\gamma-1} = \frac{T_2}{T_2}$
2.	Change in Internal energy (du)	$mc_v(T_2-T_1)$	$mc_v(T_2-T_1)$	0	$mc_v(T_1-T_2)$
3	work done	0	$P(V_2-V_1)$	$P_1V_1\log_e\frac{V_2}{V_1}$	$\frac{P_1V_1 - P_2V_2}{\gamma-1}$
4	Heat transfer (dQ)	$mc_v(T_2-T_1)$	$mc_p(T_2-T_1)$	$P_1V_1\log_e\frac{V_2}{V_1}$	0
5	change in enthalpy (dH)	$mc_p(T_2-T_1)$	$mc_p(T_2-T_1)$	0	$mc_p(T_2-T_1)$
6	change in entropy (ds)	$mc_v\log_e\frac{T_2}{T_1}$	$mc_p\log_e\frac{T_2}{T_1}$	$mR\log_e\frac{T_2}{T_1}$	$ds = 0$ (or) $(S_2-S_1) = 0$ (or) $(S_2 = S_1)$

- Heat supplied, work done, heat rejection & compression then the cycle is completed.

  The order of cycle is - HA → WD (expansion) → HR → compression
- NO heat rejection in case of expanssion process then it should be adiabatic and also it is for compression process.

Cycle :-

- when a system after undergoing a number of process is called or is able to attain its original condition, it is then said to have completed a cycle.
- IF a cycle is not completed, then continous work will not be obtained.
- The following are the requirment for completing a cycle.
  i.e, HA, HR, Expansion (useful WD) & compression.

Ideal cycle :-

An ideal cycle is cycle in which both the expanssion and compression Process must take place reversily & Adiabatically.

I.C. Engines :-

An I.C.engine is the engine in which the combustion takes place inside the engine, besides all the operations required for a complete cycle take places inside the engine. thus the I.C.engine (his by itself a complete plant).

Only costly liquid and gaseous fuel can be used for I.C. engines.

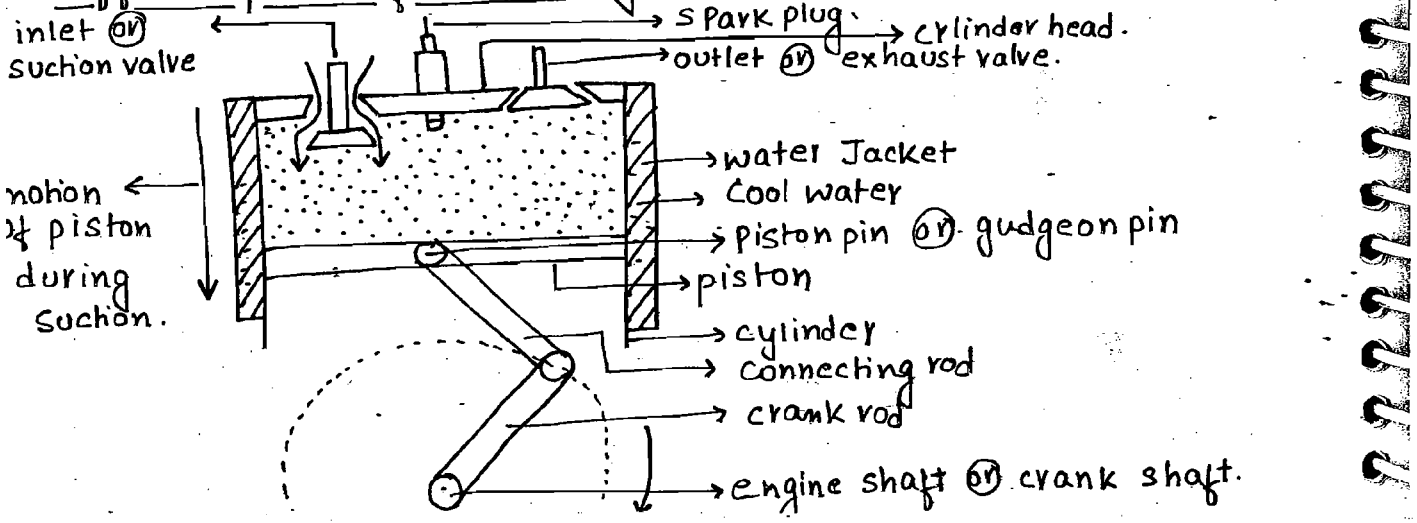
External combustion engine :-

An external combustion engine is the engine in which the combustion take place on the outside of the engine. exceptig the expanssion process, the rest of the operation are carried out outside the engine.

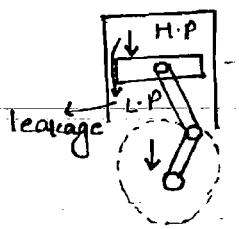
cheaper solid fuels can also be used for external combustion engines.

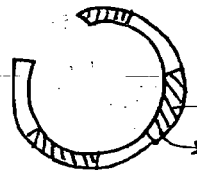
when a cycle is taken into account by considering only the expanssion process, then the efficiency of the external combustion engine is higher than that of the internal combustion engines.

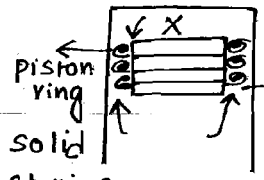
Different parts of an I.C.engine :-



Leakage is more → engine starting create problem.

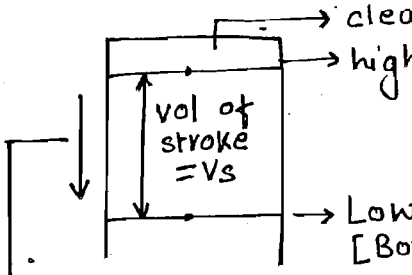






- compression ratio is same for all cycle.

→ Thermodynamics of I-c-engine :-



$$C = \frac{V_c}{V_s} \quad *$$

→ Vc is not in motion piston is not move on the top.

- clearance is provide in the cylinder because the pressure is still inside the cylinder.
- In case of heat addition the diesel engine, the volume will change.

Clearance ratio :-

The ratio of the clearance volume to stroke volume is defined as the clearance ratio of the engine.

It is given by,

$$\boxed{C = \frac{V_c}{V_s}} \quad *$$

Volume ratio :-

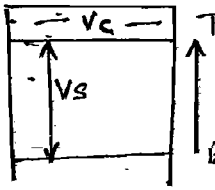
The ratio of longer volume to lesser volume during any process inside an I-c engine is defined as the volume ratio of that process. the volume ratio during compression is known as compression ratio. compression ratio remains same for all the cycles of I-c engines.

The volume ratio during the expanssion process is known as expanssion ratio & is different for different cycle of I-c engine.

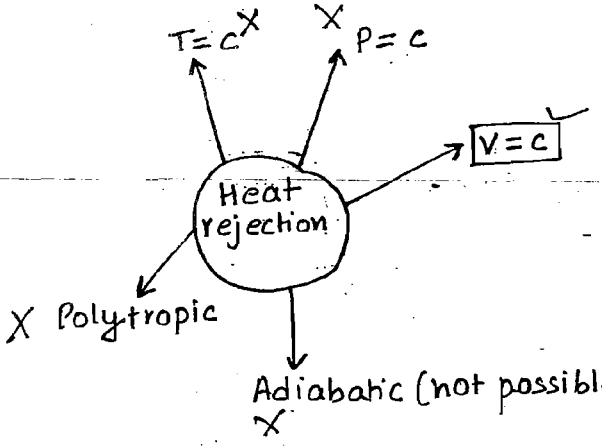
⇒ The compression ratio is :-

$$\boxed{r = \frac{V_1}{V_2}} \qquad \boxed{V_2 = V_c} \quad 2$$

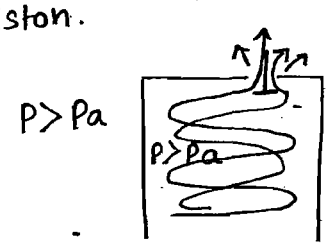
$$\boxed{r = \frac{V_c + V_s}{V_c}} \qquad \boxed{V_1 = (V_c + V_s)} \quad 1$$



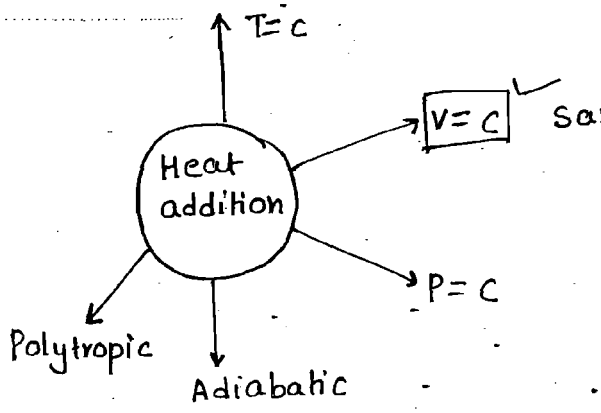
(or), $r = 1 + \frac{V_s}{V_c} \Rightarrow \boxed{\frac{V_s}{V_c} = (r-1)}$ **



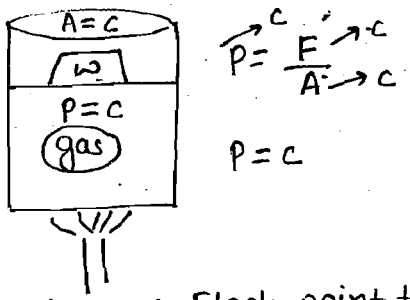
Piston is change its direction inside the cylinder during expanssion is over, then piston is at BDC piston.



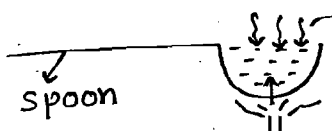
95% gas is leaving this outlet valve



Same as for heat rejection.



- For any fuel is to be burn then it is should be at Flash point temp.
- Fire point temp - minimum temp so fuel to be burn at the burner.
- spark plug is behaves like a burner.
- Fire point temp to Flash point temp then spark plug is takes place continously.
- Compression ratio in petrol engine is less (6 to 8) in comparision to that of diesel engine (and it is 15 to 16).
- No need of Burner in diesel engine so it is not have any spark plug required.
- Temp is very high in diesel engine so that the fuel is automatically burned & this process is called a self ignition temp.



This is a self ignition temp.

— Diesel cycle → pressure is constant
— Nicolus August otto → Gives at a constant volume.

Due to engine limitations, heat rejection will take place at constant volume only forall the cycle of I-C engine.

Hence, the following operation are the same forall the ideal cycle of I-C engine.

— Isentropic exapansion.
— Isentropic compression.
— Heat rejection at const volume.