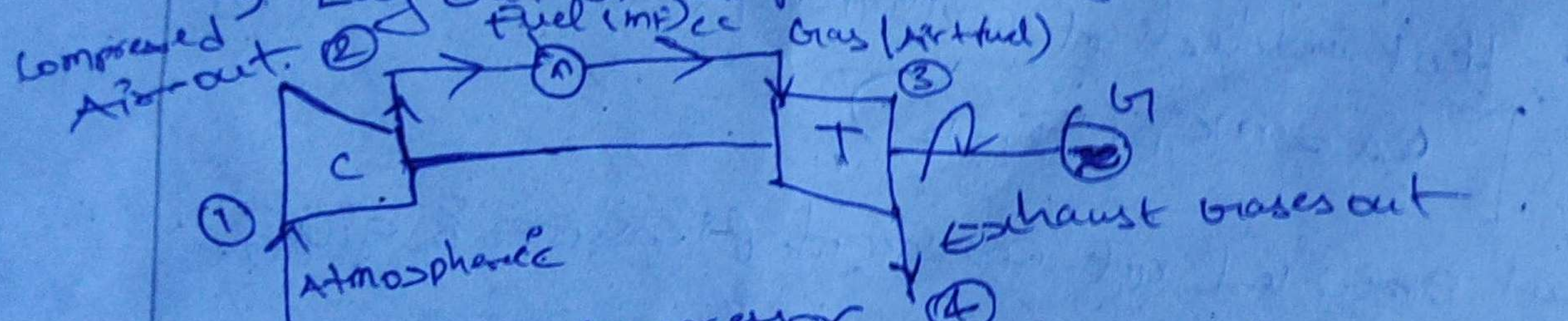
* Brayton cycle *

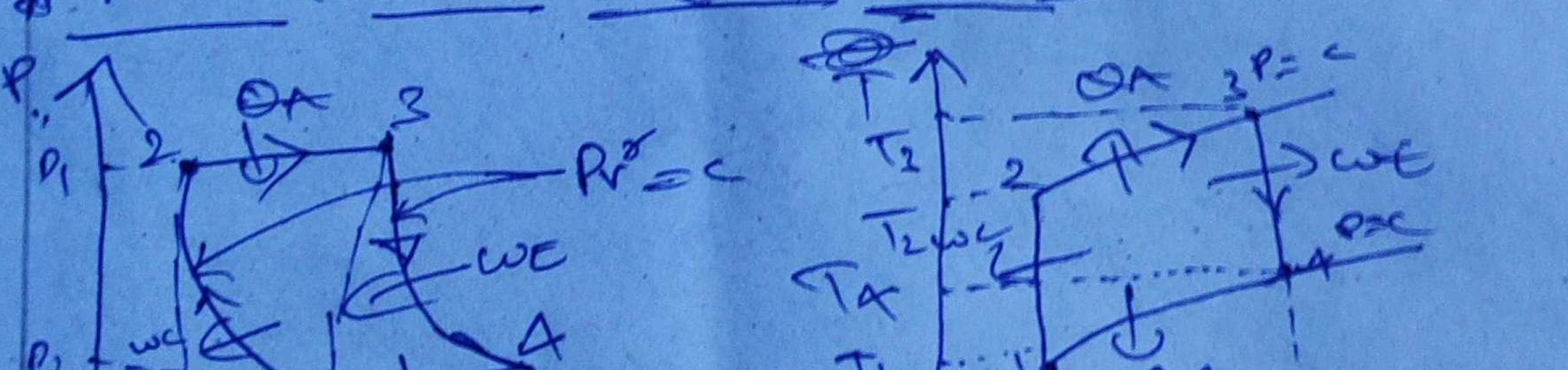
→ Brayton cycle is also called as Joule cycle
→ It is also called constant pressure cycle ~~cycle~~
→ It is for a perfect gas or ideal gas
→ This cycle is used as a basis for gas-turbine
→ It is used for gas-turbine power plants & Air-craft engines

→ Lay out of simple open cycle gas turbine:-



where C = compressor
C.C = combustion chamber
T = Turbine
G = Generator

* P-v & T-s diagram for Brayton cycle *



→ The processes that take place in Brayton cycle are:-

i) process 1-2 :- Reversible adiabatic or Isentropic compression
ii) process 2-3 :- constant pressure heat-addition
iii) process 3 to 4 :- Reversible adiabatic or Isentropic expansion

iv) process 4 to 1 :- constant pressure heat rejection

∴ Thermal efficiency of Brayton cycle is given by :-

$$\eta_{Brayton} = \frac{\text{Heat added} - \text{Heat rejected}}{\text{Heat added}}$$

$$\eta_{Brayton} = \frac{Q_A - Q_R}{Q_A}$$

$$\boxed{\eta_{Brayton} = 1 - \frac{Q_R}{Q_A}}$$

∴ Heat added at constant pressure is given by

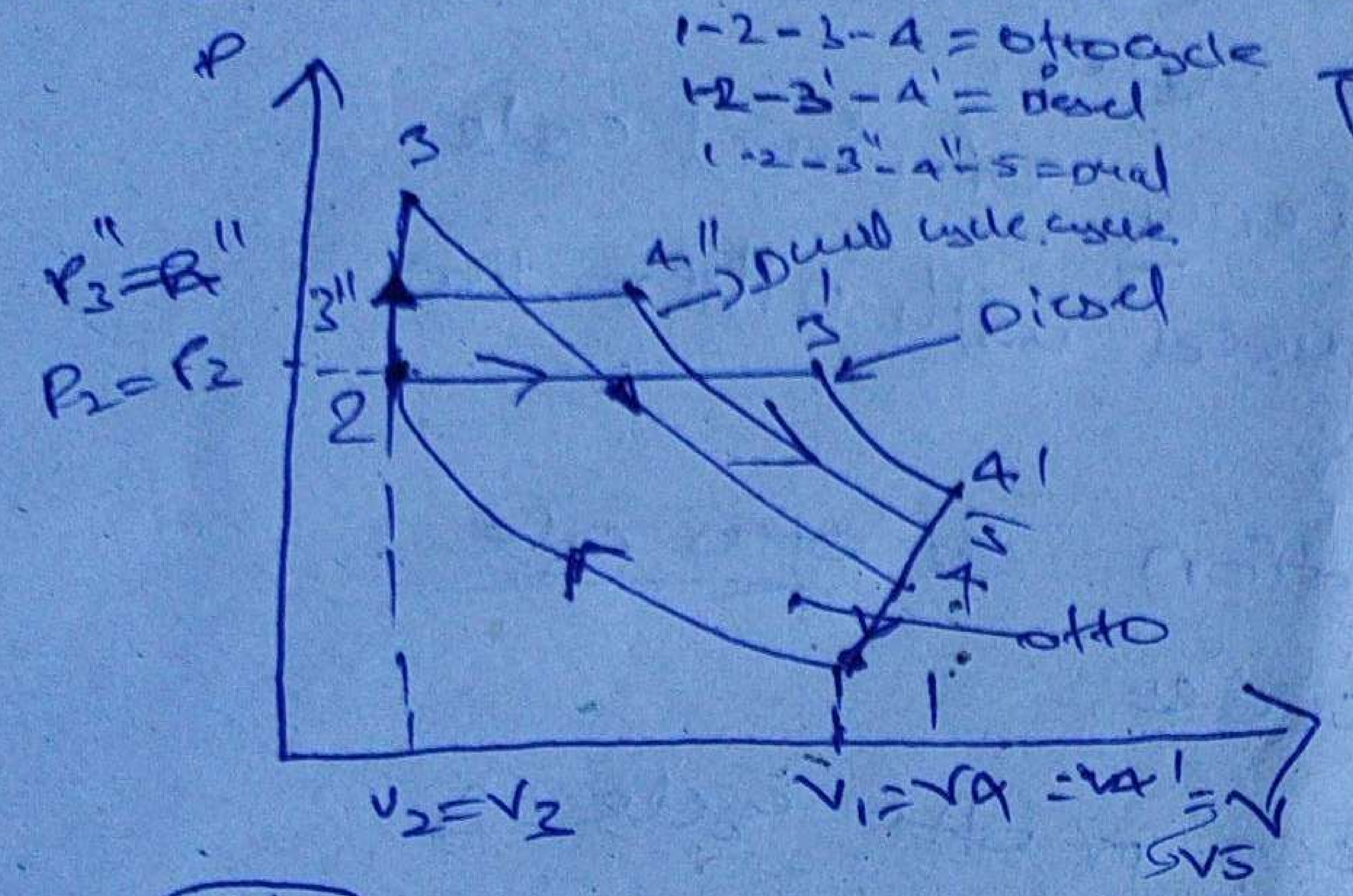
$$\boxed{Q_A = mC_p(T_3 - T_2)}$$

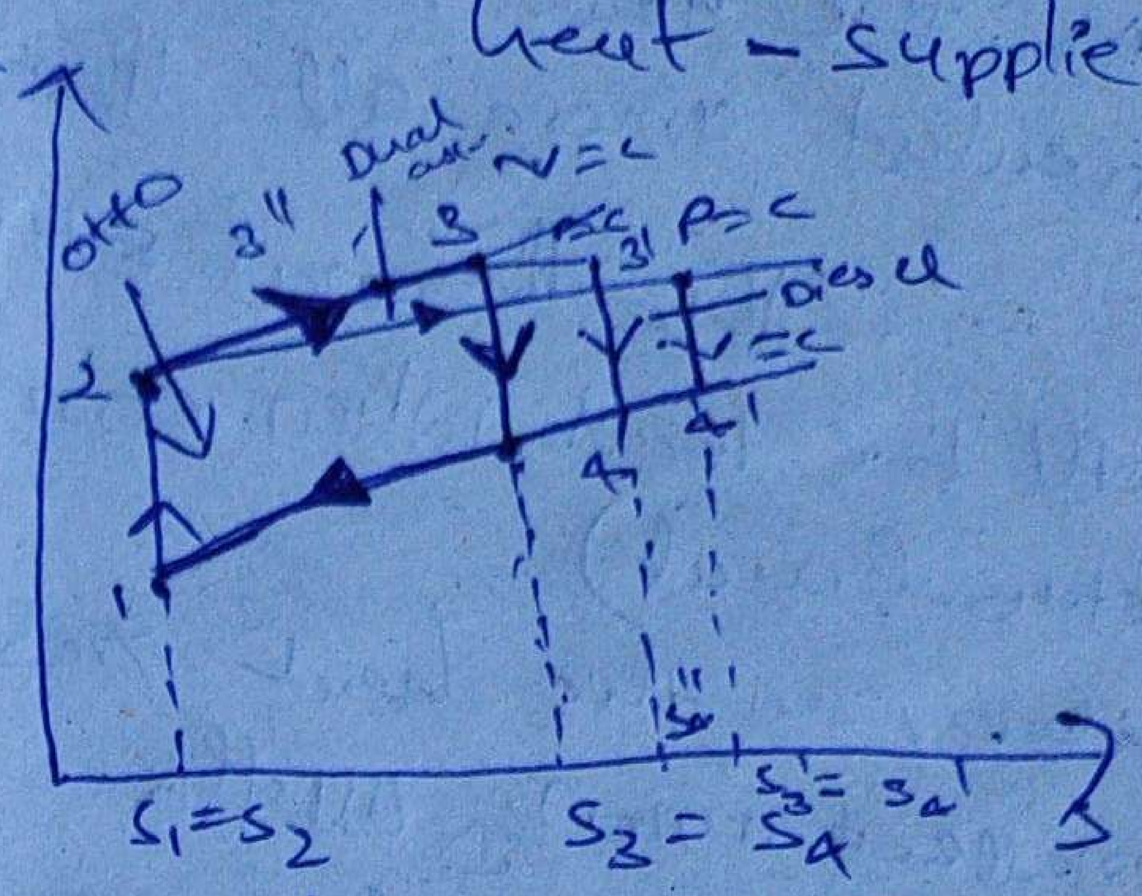
Heat rejected at constant pressure is given by :-

$$\boxed{Q_R = mC_p(T_4 - T_1)}$$

→ Comparison of Otto cycle Diesel cycles & dual

* for same compression ratio & dual cycle:- heat - supplied





∴ The efficiency of Air standard cycles

i.e; the thermal efficiency is given by:-

$$\boxed{\eta_{th} = \frac{\text{Workdone}}{\text{Heat - supplied}}}$$

$$\left[\eta_{th} = \frac{Q_A - Q_R}{Q_A} \Rightarrow 1 - \frac{Q_R}{Q_A}\right] \text{— (1)}$$

∴ The amount of heat - supplied for all the cycles are considered as same.

∴ The only parameter on which the thermal efficiency depends is Heat

∴ From Eq, no 1, It is clear that η_{th} of a cycle depends only upon Q_R as the heat supplied is taken as constant

$$\text{so, } \eta_{th} \uparrow \; Q_R \downarrow$$

→ The heat rejection temperature differences are;

i) For otto cycle :- $Q_R = mc_v(T_4 - T_1) \Rightarrow c_v(T_4 - T_1)$ kJ/kg

ii) For Diesel cycle :- $Q_R = mc_v(T_4' - T_1) \Rightarrow c_v(T_4' - T_1)$ kJ/kg

iii) For Dual cycle :- $Q_R = mc_v(T_5 - T_1) \Rightarrow c_v(T_5 - T_1)$ kJ/kg

$Q_R > Q_R > Q_R$

As, the heat rejection of "Diesel cycle" is greatest among all three cycles.

$\therefore$ The thermal efficiency of Diesel cycle will be least when compared with other two (otto & dual)

Also, as the heat rejection of otto cycle is smallest among all three cycles.

$\therefore$ The thermal efficiency of otto cycle will be maximum.

$\therefore$ ~~for~~ same compression ratio & heat - supplied

$$\left[\eta_{otto} > \eta_{dual} > \eta_{Diesel}\right]$$