

# HEAT ENGINES

Heat engine is a device by which a system is made to undergo a cyclic process that results in conversion of heat to work

There are 4 features in the Heat Engine

# 1. Working substance

A mixture of fuel vapour and air in a gasoline or diesel engine or steam in a steam engine are the working substances

## 2. Hot Reservoir

It has infinite thermal capacity kept at high temperature ( $T_1$  K). Working substance absorbs a total amount of heat  $Q_1$  from an external reservoir at some high temperature  $T_1$

### 3. Cold Reservoir

It is kept at some lower temperature ( $T_2$ ) and also having infinite thermal capacity. Working substance releases a total amount of heat  $Q_2$  to an external reservoir after performing external work during the cyclic process.

# 4

The work done ( $W$ ) by the system in a cycle is transferred to the environment via some arrangement.

Continuous work can be performed during the Cyclic Process

# Efficiency

Heat absorbed by the working substance is  $Q_1$  and it rejects  $Q_2$  amount of heat after doing work.

Then Work done  $\mathbf{W = Q_1 - Q_2}$

Then Efficiency

$$\eta = \frac{\text{Output (Work)}}{\text{Input Energy}} = \frac{W_1}{Q_1} = \frac{Q_1 - Q_2}{Q_1}$$

$$\eta = 1 - \frac{Q_2}{Q_1}$$

Later we prove

$$\eta = 1 - \frac{T_2}{T_1}$$

For  $Q_2 = 0$ ,  $\eta = 1$ , Then the engine will have 100% efficiency in converting heat into work.