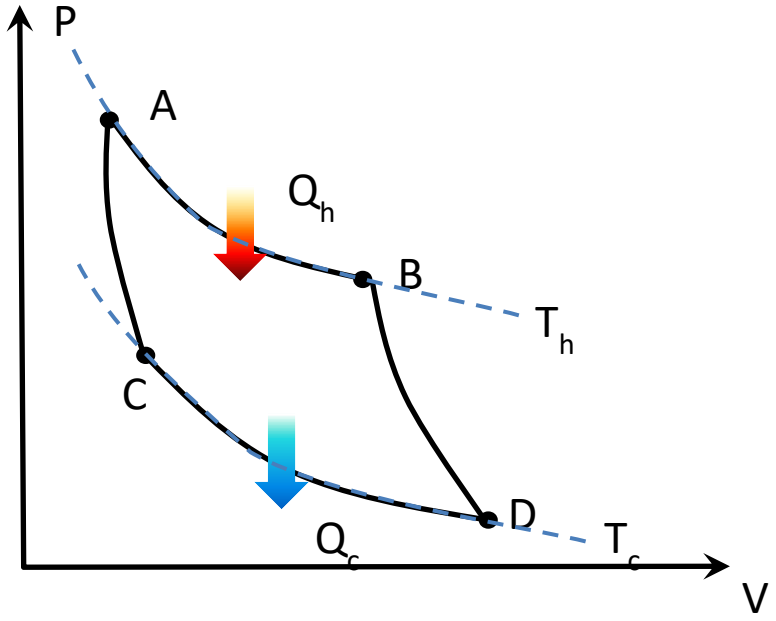
Carnor cycle.

During last class we discussed Carnot cycle. It is shown schematically in Figure 1.



This cycle describes the operation of a theoretical engine which is called Carnot engine. It is named after French engineer Sadi Carnot.

Sadi Carnot (1796-1832)

The Carnot cycle includes four processes, as we can see in Figure 1.

1. Process AB is an isothermal expansion at temperature T_h (h means "heater"). During this process, the gas performs work (expands) and obtains heat Q_h from the heat reservoir, or ,simply, the heater.
2. In process BD the gas expands, but it is thermally isolated (receives no heat). During this process the temperature falls from T_h to T_c (c means "cooler").
3. Process DC. The gas is compress isothermally at temperature T_c. During this process the work is done on the gas and the gas looses heat Q_c.
4. Process CA. The gas is compressed like in process CD but now it is thermally isolated. The work is done on the gas and the gas is heated up to temperature T_h.

It is very important that all four processes are performed very slow – in "almost reversible" way" We will discuss this statement in detail later.

Let us define the thermal efficiency of an engine as the ratio of work done by the engine during the cycle to the amount of heat which was "fed" to the engine during the cycle. The efficiency can not be higher than 1 due to energy conservation. The closer the efficiency to 1 the better the engine. Carnot demonstrated that the thermal efficiency of an engine based on the Carnot cycle is:

$$\eta_{carnot} = \frac{T_h - T_c}{T_h} = 1 - \frac{T_c}{T_h}$$

Moreover, Carno demonstrated that ***no real engine operating with the same heater and cooler temperatures can have efficiency higher than the Carnot engine.*** (This statement is called "Carnot theorem").