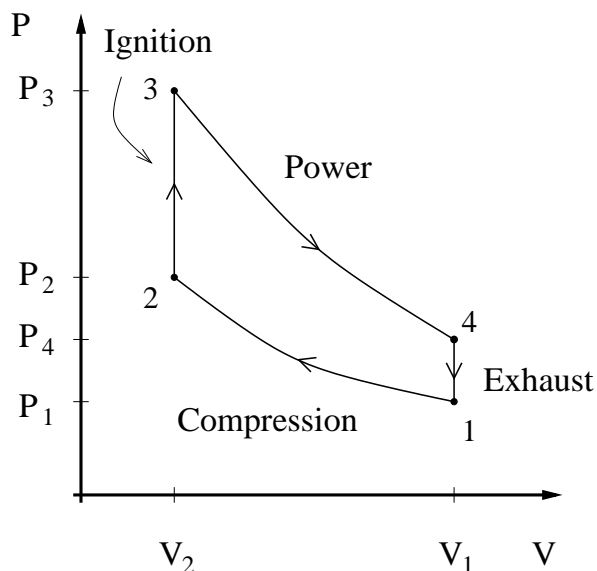


Midterm Exam 1 (PY 413, Spring 2007)

1. A glass containing 150g of water is heated in a 600 Watt microwave oven. Starting from room temperature, $T = 20^\circ\text{C}$, how long does it take for the water to boil? Assume that no energy is wasted. The specific heat of water is $c(\text{H}_2\text{O}) = 4.186 \text{ J}/(\text{g}\cdot\text{K})$.
2. The figure shows an approximate PV diagram for a gasoline engine. In the following we shall assume that the working substance is an ideal diatomic ($f = 5$) gas and that the power and compression strokes are adiabatic.



- (a) The initial volume is $V_1 = 1 \text{ liter}$ ($1 \text{ l} = (10 \text{ cm})^3$), the initial temperature and pressure are $T_1 = 293 \text{ K}$ and $P_1 = 1 \text{ atm}$. The compression ratio is $V_1/V_2 = 10$. Compute the temperature T_2 and the pressure P_2 .
- (b) Compute the amount of work W_{12} required to compress the gas.
- (c) During the ignition stage the temperature of the gas is further raised to $T_3 = 1200 \text{ K}$. Compute the amount of heat Q_{in} transferred to the gas.
- (d) In the power stroke the volume changes adiabatically back to V_1 . What is the amount of work W_{34} being done during the expansion? The efficiency ϵ is defined as the ratio of the net (total) work done over the heat input Q_{in} . Compute ϵ .