1. A simple gas turbine cycle has inlet conditions of 300 K and 1 atm. The pressure ratio is \( r_P = P_2/P_1 = 8 \), and the heat addition, per unit mass, is \( q_H = 1200 \text{ kJ/kg} \). Both the turbine and the compressor are isentropic.

(a) Assuming constant specific heats, with values taken at room temperature, calculate the temperature at the compressor exit, the combustor exit and the turbine exit, the thermal efficiency, and the net work per unit mass.

(b) Repeat the previous problem, except now use the air tables.

2. A simple gas turbine cycle has inlet conditions of 300 K, 1 atm, and a maximum temperature of 2000 K. Both the compressor and the turbine can be considered ideal. Find the minimum mass flow rate, and associated pressure ratio, necessary for the turbine to produce a power output of 2 MW.

3. Consider problem 1), with the same \( r_P \) and \( q_H \). Say that the turbine and the compressor have equal isentropic efficiencies of \( \eta_c = \eta_t \). Assuming constant specific heats, calculate and plot the thermal efficiency of the cycle as a function of \( \eta_c \) ranging from 1 (isentropic behavior) downwards. What value of \( \eta_c \) results in zero thermal efficiency for the cycle?