Problem 1:

The core of a certain gas turbine system, as drawn on the board, has a compressor, a combustor, and a turbine. You are given the following system specifications:

T_{ta}= 300 K (compressor inlet total temperature)
T_{tc}= 1800 K (high pressure turbine inlet total temperature)
r_c= 15 (compressor total pressure ratio)
$\dot{m}$ = 75 kg/s
Pt_a=Pt_d=1 bar

You may assume that air behaves as an ideal gas with cp=1000 J/kgK everywhere. You may assume that the compressor and turbine are reversible.

- **a) What is the power output of the system?**
- **b) What is the efficiency of the gas turbine system?**

Suppose an ideal regenerator (100% regeneration) is added to the system as shown on the board.

- **c) What is the efficiency of the cycle with the regenerator added?**
- **d) Assuming the cycle produce the same power, what is the difference between the heat input required, without and with the regenerator?**

Problem 2:

A certain fuel burns at a temperature of 2100 K producing 45 kJ/kg of heat. It is proposed to operate a Carnot heat engine between the burning fuel and the atmosphere at T=300 K (80 F). **Determine the work output of this heat engine.**

The work output from the heat engine is used to drive a Carnot refrigerator. The refrigerator is used to cool a room at a constant temperature of 290 K (62 F), and rejects heat to the same atmosphere. Find:

- **a)** The coefficient of performance (COP).
- **b)** The amount of heat removed from the room in kJ/kg.

Now, suppose that the atmosphere temperature has increased to 310 K (98 F) on a hot summer day. Assuming that the refrigerator removes the same amount of heat from the room, **determine the work in kJ/kg required to drive the refrigerator.**