

Assignment 7

1. Air at 20 °C and 1.05 bar occupies a volume of 0.025 m³ (point 1). The air is heated at constant volume until the pressure is 4.5 bar (point 2), and then it is cooled at constant pressure back to the original temperature (point 3).
 - (a) Draw this process on the P-V plane, labelling the points.
 - (b) Calculate the net work done, W_{net} . Is work being done on the gas or is the gas doing work on something external?
 - (c) Calculate the net heat transferred, Q_{net} . Is heat leaving the gas or is heat being added to the gas?

2. Air flows into a gasoline engine at 95 kPa and 300 K. The air is then compressed with a volumetric compression ratio of 8:1. The combustion process releases 1300 kJ/kg of energy (i.e. q_h) as the fuel burns. Find the temperature and pressure after combustion before the power stroke. The working substance is well approximated as air with a specific heat of $c_V = 717$ J/K/kg.

3. Do Problem 4.22 in the text.

4. An air conditioner operates on 800 W of power and has a coefficient of performance of 2.80 with a room temperature of 21.0 °C and an outside temperature of 35.0 °C.
 - (a) Calculate the rate of heat removal for this unit.
 - (b) Calculate the rate at which heat is discharged to the outside air.
 - (c) Calculate the total entropy change in the room if the air conditioner runs for 1 hour. Calculate the total entropy change for the outside air in the same time period.
 - (d) What is the net change in entropy for the system (room + outside air)?

5. Do Prob. 4.30 in the text, but let the pressure operate between 1 bar and 12 bars (rather than 10 bars). For part (b), just calculate the COP and omit the remainder of that part of the question.