1. Please explain the following terminologies in thermodynamics: (25%)
   a. Quasi-equilibrium process (4%)
   b. reversible work (4%)
   c. entropy (4%)
   d. exergy (5%)
   e. Clapeyron equation (4%)
   f. partial molar property (4%)

2. Air is compressed adiabatically from 1 bar and $27^{\circ}C$ to 10 bars in a piston cylinder device with air of 10 kg. Please determine the power input required and the final temperature reached for a reversible process (assume that c_p and c_v of air are constant and = 1 kJ/kg$^{\circ}$K, 0.717 kJ/kg$^{\circ}$K). (25%)

3. One kilogram of air in a rigid insulated tank is initially at $P_1 = 1$ bar and $T_1 = 300^{\circ}$K. The air is stirred by a paddle wheel until its temperature is 400°K. Please determine a) the actual work done and b) the minimum work done. (25%)

4. An insulated tank is divided into two compartments by a partition. One compartment contains 2 kmol of CO_2 at $27^{\circ}C$ and 200 kPa, and the other compartment contains 3 kmol of Ar gas at $47^{\circ}C$ and 400 kPa. Now the partition is removed and the two gases are allowed to mix. Please determine the final T and P of the mixture and 2) the entropy changes during the process. Assume that the c_p and c_v of CO_2 are constant and equal 0.846 kJ/kg$^{\circ}$K, 657 kJ/kg$^{\circ}$K; c_p and c_v of Ar are also constant and equal 0.52 kJ/kg$^{\circ}$K, 0.31 kJ/kg$^{\circ}$K respectively. Both gases are assumed as ideal gas. (25%)