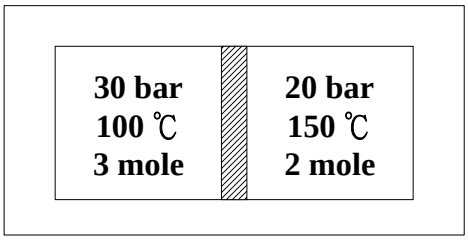
明新科技大學化工研究所 92 年度碩士班　化熱與動力　　試題

☆ 可使用*非記憶性*電子計算機；第 1~4 題為熱力學，請答在一張答案卷上，第 5~8 題為動力學，請答在另一張答案卷上。

1. An isolated container is divided into two compartments by a plate as shown below. Initially each compartment is filled with nitrogen at the condition specified in the figure. If the plate is removed, calculate (9%)
   (a) Final temperature
   (b) Final pressure
   (c) The entropy changes of this system ?



2. An ideal gas (10 m^3, 1 bar and 27 ^oC) is compressed to 10 bar by the following processes (16%)
   (a) Reversible isothermal compression
   (b) Reversible adiabatic compression
   Please find the final temperature, pressure, Q、W、 U、 H of each process.

3. In order to maintain a cold locker at –35 ^oC, it is necessary to withdraw heat at a rate of 1800 BTU/h. A device is reported to be able to do this with a mechanical work input of 100 W and additionally, a flow of air at 45 ^oC, 1 atm into the device at a rate of 500 SCFM. It is discharged at the same rate at 30 ^oC, 1 atm. A thermal sink at 30 ^oC must be available. Take the air to be an ideal gas with C_p=7/2 R. Please find: (15%)
   (1) How much heat is rejected to the sink?
   (2) Entropy change=?
   (3) Entropy production=?

4. For an ideal gas prove that: (10%)

$$\Delta S/R = \int (Cv/R)(dT/T) + \ln(V/V_o)$$

5. We wish to produce B in the reaction system (10%)

$A \rightarrow B \qquad -r_A = k_1 C_A$

$A \rightarrow C \qquad -r_A = k_2 C_A$

A costs \$15/kg-mol, *B* sells for \$50/kg-mol and *C* costs \$8/kg-mol to dispose.

(1)What value of k_1/k_2 will balance a cash flow if the reactor and operating costs are ignored?

(2) What value of k_1/k_2 will give a 50% profit on sale if the reactor and operating costs are ignored?

6. Acetaldehyde decomposes homogeneously at temperatures of several hundred degrees Celsius to produce methane and carbon monoxide, $CH_3CHO \rightarrow CH_4 + CO$. Please show that the rate of this reaction obeys 3/2 order in acetaldehyde by a method of pseudo-steady-state approximation. This reaction is actually a multi-reaction system that involves the major steps: (15%)

$CH_3CHO \rightarrow CH_3 + CHO$

$CH_3CHO + CH_3 \rightarrow CH_4 + CH_3CO$

$CH_3CO \rightarrow CH_3 + CO$

$CH_3 + CH_3 \rightarrow C_2H_6$

7. For the reaction in series $A \xrightarrow{k_1} R \xrightarrow{k_2} S$, $k_1=k_2$. Find the maximum concentration of R and when it is reached. (15%)

8. Liquid A decomposes by first-order kinetics, and in a batch reactor 50% of A is converted in a 5-minute run. How much longer would it take to reach 75% conversion? (10%)

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