

ChE 201 – Spring 2002 – Exam #2 – 100 points – Closed Book – Closed Notes

Put your ID# (no name) on your blue book and your exam. **Don't write on the pink sheets.**

When using Table B.2, use only the A term for C_p (e.g. $C_p = A$). You have 110 minutes.

1. (10 pts) Using standard heats of formation, calculate the standard heat of combustion of vapor-phase acetone, $\text{CH}_3\text{C}(\text{O})\text{CH}_3$.
2. 100 mol/min of H_2SO_4 at 25 °C are mixed with 1000 mol/min of water at 25 °C in a continuous process which takes place at 25 °C.
 - a. (5 pts) Calculate the composition of the product solution in mole per cent.
 - b. (5 pts) Should heat be continuously added or removed to keep the process at 25 °C?
 - c. (10 pts) Calculate the rate at which heat must be transferred to maintain the process at 25 °C.
3. Ethanol can be produced by reacting ethylene with water. An ethylene hydration reactor operates at 1 atm and 200 °C, and achieves 80 % conversion of ethylene. 100 mole/min of ethylene are fed at 1 atm and 25 °C as a mixture of 75 mole % ethylene and 25 mole % nitrogen. 125 mole/min of water are fed at 1 atm and 200 °C.
 1. (30 pts) Calculate the quantity of heat that must be transferred to keep the reactor operating continuously at 200 °C.
 2. (10 pts) Would you select water or high-pressure steam as your utility stream? Explain.
4. A reactor effluent stream contains 20 mol % ethanol and 80 mol % nitrogen at 1 atm and 100 °C. The boss wants it cooled to 30 °C in a heat exchanger that operates at 1 atm.
 - a. (20 pts) Determine the amount of heat that must be transferred in the heat exchanger per 100 moles of reactor effluent.
 - b. (10 pts) If water is the utility stream in the heat exchanger, specify a reasonable inlet and outlet temperature and flow rate for the water. (Note that there is more than one correct answer to this problem.)