1. An off gas of the following composition: 30.0% CO, 30.0% H_2, 10% CH_4, and 30% N_2 is burned with 10% excess air. The barometer reads 760 mmHg. Calculate the dewpoint of the stack gas. ($\ln P^*_{water}$ (mmHg) = 18-(3820/(-46+T(K))) (20%)

2. In a first-order reaction, the half-lifes of the thermal decomposition of CCl_4 were 500 and 3500 seconds at 340 and 330 K, respectively. Calculate the enthalpy and entropy of activation at 330 K. (20%)

3. A waste stream of 20,000 gal/day contains 270 mg/L of cyanide as NaCN. Determine the theoretical (stoichiometric) amount of chlorine required daily to destroy this waste. (20%)

4. In a hazardous waste incineration process, 1,000 m^3/min of flue gas at 600 K is contacted with a lime slurry in a dry scrubber where acid gases are partially neutralized and gases cooled to 430 K. The flue gas contains 300 kg/hr of SO_2 and 200 kg/hr of HCl. The dry scrubber has 80% efficient in removing SO_2 and 90% efficient in HCL removal. What is the lime feed rate in kg/hr? (20 %)

5. A liquid injection incinerator has a stack gas that contains 7% oxygen by volume on a wet basis at standard conditions. The incinerator is burning benzene at a rate of 234 kg/hr with air. (a) What percent excess air is required? (b) If the stack gas had been on a dry basis, what would the excess air be? (c) What is the combustion efficiency of the system if the CO content of the flue gas is 600 ppmv? (20%)