Homework 14
Due Monday 11/28

1. (7.5 pts) Wet wood chips are dried in a continuous rotary dryer that operates at atmospheric pressure. The chips enter at 19°C with a water content of 40% w/w and must leave with a moisture content of less than 15% w/w. Hot air is fed to the dryer at a rate of 11.6 m³(STP)/kg wet chips.

Monitoring the moisture content of the chips would be costly and could not be easily automated. So the performance of the dryer is determined by material balance using wet- and dry-bulb measurements of the inlet and outlet air.

The inlet dry-bulb temperature is 100°C and the wet-bulb temperature is so low that that the water vapor in the inlet air may be ignored. The outlet air has a dry-bulb temperature of 38°C and a wet-bulb temperature of 29°C.
   a) Use the psychrometric charts to determine the absolute humidity and specific enthalpy of the inlet and outlet air streams.
   b) Calculate the moisture content of the chips leaving the dryer. You may assume that dry air has a molecular weight of 29.0 g/mol.
   c) Assuming that the dryer operates adiabatically and that the heat capacity of the chips is a constant 2.10 kJ/kg-K, what is the temperature of the chips as they leave the dryer?

3. (7.5 pts) Cold saturated air (10°C) at 10 m³ dry air per minute is mixed with warm air (35° C dry-bulb and 25 °C wet-bulb) at 5 m³ dry air per minute. After performing a mass and energy balance,
   a) What is the mass fraction of water vapor in the mixed air?
   b) What is the absolute humidity of the mixed air?
   c) What is the enthalpy of the mixed air?
   d) Using that information, what is the dry-bulb temperature and relative humidity of the mixed air?

4. (5 pts) Air enters a cooling tower at 40°C and 20% RH and exits at 26°C after adiabatic, evaporative cooling. Using the psychrometric chart, find the following properties of the exit air:
   a) Wet-bulb temperature
   b) Relative humidity
   c) Dew point
   c) Absolute humidity