MEBS6006 Environmental Services I

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Exercises on Psychrometry

(* Adapted from *ASHRAE Fundamentals Handbook 2009*, Chapter 1)

1. Moist air exists at 40°C dry-bulb temperature, 20°C thermodynamic wet-bulb temperature, and 101.325 kPa pressure. Determine the humidity ratio, enthalpy, dew-point temperature, relative humidity, and specific volume.

2. Moist air, saturated at 2°C, enters a heating coil at a rate of 10 m^3/s. Air leaves the coil at 40°C. Find the required rate of heat addition.

3. Moist air at 30°C dry-bulb temperature and 50% rh enters a cooling coil at 5 m^3/s and is processed to a final saturation condition at 10°C. Find the kW of refrigeration required.
(Given data: specific enthalpy of water at 10°C under standard atm. pressure is 42.11 kJ/kg)

4. A stream of 2 m^3/s of outdoor air at 4°C dry-bulb temperature and 2°C thermodynamic wet-bulb temperature is adiabatically mixed with 6.25 m^3/s of recirculated air at 25°C dry-bulb temperature and 50% rh. Find the dry-bulb temperature and thermodynamic wet-bulb temperature of the resulting mixture.

5. Moist air at 20°C dry-bulb and 8°C thermodynamic wet-bulb temperature is to be processed to a final dew-point temperature of 13°C by adiabatic injection of saturated steam at 110°C. The rate of dry airflow is 2 kg/s (dry air). Find the final dry-bulb temperature of the moist air and the rate of steam flow.

6. Moist air is withdrawn from a room at 25°C dry-bulb temperature and 19°C thermodynamic wet-bulb temperature. The sensible rate of heat gain for the space is 9 kW. A rate of moisture gain of 0.0015 kg_w/s occurs from the space occupants. This moisture is assumed as saturated water vapor at 30°C. Moist air is introduced into the room at a dry-bulb temperature of 15°C. Find the required thermodynamic wet-bulb temperature and volume flow rate of the supply air.