ME 306
Psychrometry Tutorial Sheet

Assume a system pressure of 1 atm, unless specified otherwise

Q1. A system containing moist air has a DBT of 30°C, and the dew point is 20°C. If the system pressure is 1 atm. Determine

   a) pressure of water vapour,
   b) humidity ratio,
   c) relative humidity,
   d) specific enthalpy,
   e) specific volume.

Q2. From the psychrometric chart, read of the properties of the following states:

   (a) DBT = 40°C, ω = 15 g/kg.d.a;
   (b) DBT = 40°C, WBT = 25°C;
   (c) DBT = 35°C, RH = 65%;
   (d) DBT = 30°C, DPT= 30°C

Q3. A sample of moist air has DBT 43°C and WBT 29°C. Without using the chart, determine partial pressure of water vapour, specific humidity, relative humidity, dew point temperature, humid specific heat, enthalpy, and degree of saturation.

$$Pv = P_{wbt} - \frac{(P - P_{wbt})(T_{dbt} - T_{wbt})}{1544 - 1.44\,T_{wbt}}$$

Where, Pv is the partial pressure of water vapour

P_{wbt} is the saturation pressure corresponding to the wet bulb temperature (from steam tables)

T_{dbt} is the dry bulb temperature in °C

T_{wbt} is the wet bulb temperature in °C

Q4. Estimate the power required to heat 2 kg.d.a/s of air from 10°C, 80% RH to 50°C, without the addition of moisture. If you use the dry air formula (i.e. cp of air only), what will be the difference in the answer?

Q5. A cooling coil is used to cool moist air from 30°C, 60% RH to 15°C, 80% RH. Estimate the sensible and latent heat of the cooling coil per kg of dry air using the (a) psychrometric chart and the enthalpy formula. (b) Calculate the condensate mass flow rate per kg of dry air.

Q6. 50 kg/s of air at 5°C, 100% RH, is mixed with 150 kg/s of air at 40°C, 60% RH. The mixing is adiabatic. Determine the state of the mixed stream.

Q7. 250 kg/h of air at 2°C, 100% RH is mixed with 50 kg/h of air at 35°C, 80% RH, in an adiabatic mixer. What is the final state of air?

Q8. Dry saturated steam 1 atm is injected into a flowing air stream. The inlet state of air is DBT 21°C, sp. humidity 5.7 g/kga. The exit specific humidity is 14.3 g/kga. Determine the exit DBT and the steam flow rate is kg/kga.

Q9. Air at 30°C DBT, 60% RH flows over a cooling coil whose external surface is maintained at 5°C. The bypass ratio of the coil is 0.2 and the condensate is drained at 10°C. Determine the state of exit air, the rate of condensate removal, and the rate of heat removal in the coil.

Q10. The amount of air supplied to an air-conditioned hall is 300 m^3/ min. The atmospheric conditions are 35°C DBT and 55% RH. The required conditions are 20°C DBT and 60% RH. Find the:

(a) Dry air mass flow rate supplied to the hall
(b) enthalpy of the atmospheric condition and required condition from the psychrometric chart
(c) The sensible heat and latent heat removed from the air per minute.
(d) Also find sensible heat factor from the system.