Solutions to Quick Revision Study Guide Questions

CHAPTER 1

Q1. 0.01 kg of steam with a specific enthalpy of 2,700 kJ/kg is mixed with 2.0 kg of dry air with a specific enthalpy of 20 kJ/kg. What is the specific enthalpy of the mixture?
Ans:
[Total enthalpy = 67, hence specific enthalpy = 67/2 = 33.5 kJ/kg dry air]

Q2. Moist air has a dry-bulb temperature of 30°C, and a wet-bulb temperature of 20°C. Use a Psychrometric Chart to find:

a. The percentage saturation **Ans: [38.1% (from 0.0104/0.0273 * 100)]**
b. The moisture content **Ans: [0.0104 kg/kg dry air]**
c. The enthalpy **Ans: [57 kJ/kg]**
d. The specific volume **Ans: [0.87 m^3/kg]**
e. The dew-point temperature **Ans: [14.5°C]**

Q3. Moist air at 25°C dry-bulb and 50% saturation, undergoes a process so that its condition is changed to 40°C drybulb and 30% saturation.
Use a Psychrometric Chart to determine the change in specific enthalpy for the process.
Ans:
[28 kJ/kg (from 78.5-50.5)]

Q4. The air inside a room during winter is at 20°C db and 40% saturation. If the temperature of the inside surface of a window is 9°C, will condensation form on the window glass?
Ans:
[No. (from Dew-point temperature = 6°C)]

Q5. A sling psychrometer measured the dry and wet-bulb temperatures of moist air as 27°C and 19°C respectively. Determine the moisture content from the relevant equation, given that:
(i) p_{ss} at 19°C is 2.196 kPa,
(ii) The psychrometric constant is 6.66 x 10^{-4} K^{-1}
Ans:
[Equations: p_{ss} – A x p_{at}(t_{bd} – t_{wb}); moisture content, g = 0.622 p_s / (p_{at} – p_s)
Hence: p_s = 2.196 – ({6.67 x 0.0001} x 101.325{27-19}) = 1.655 kPa
Moisture content, g = 0.622 x 1.655/(101.325-1.655) = 0.0103 kg/kg or 10.3 g/kg]

CHAPTER 2

Q1. Dry air flows over a heating coil and absorbs heat at the rate of 10 kW.
If the air temperature and pressure immediately in front of the coil are 325K and 1 bar respectively, and the mass flow rate is 0.5 kg/s, determine the temperature of the air leaving the coil.
Note any assumptions made.

Ans:

[Heat flow = Mass x Specific heat capacity x temperature difference.
Temperature difference = 10 / (1.01 x 0.5) = 19.8
Therefore leaving temperature is 325 + 19.8 = 344.8K
Assumption: Specific heat capacity of dry air is 1.01 kJ/kg K]

Q2. If moist air is at standard atmospheric pressure and the partial pressure of the water vapour is 2.486 kPa, what is the partial pressure of the dry air?

Ans:

[If standard atmospheric pressure is taken as 101.325 kPa, then partial pressure of water vapour will be 101.325 – 2.486 = 98.839 kPa]

If the moist air is now cooled (assume constant pressure), at what temperature will the water vapour start to condense?

Ans:

[Moisture content, g = 0.622 p_s / (p_{at} – p_s)
= (0.622 x 2.486)/(101.325 – 2.486) = 0.0156 kg/kg
From chart: dew point temperature = 21°C]

Q3. A person loses water by sweating at an average of 0.072 kg per hour. Assuming evaporating is taking place at 30°C, what rate of cooling does this represent?

Ans:

[Latent cooling will be: (0.072/3600) kg/s x 2450 kJ/kg = 0.049 kW or 49 W]

Q4. If air at 10°C and 100% saturation is sensibly heated to 22°C, what will be the percentage saturation at the new condition?

Ans:

[From chart: 46%]