

Exam Duration: 40 min

Problem 1: A large room contains moist air at 25°C and 60% relative humidity at 1atm = 101.325 KPa. Determine the following values in 2 different methods (1: tables and equations, 2: Psychrometric chart):

(49 marks) $R_a = 0.287 \text{ KJ/Kg.K}$

Show the points on the chart and label them where possible

- The partial pressure of water vapor? (**just formula**)
- The partial pressure of dry air? (**just formula**)
- The humidity ratio, in kg (vapor) per kg (dry air).
- The dew point, in °C.
- The mass of dry air, in kg, if the mass of water vapor is 1 kg.
- Volume of the room based on part d.
- Total enthalpy of the air in the room. (find h from the chart and use proper equation to find H)

Problem 2: External wall temperature of a building is measured at 17°C. The wall is exposed to atmosphere at 10°C in May in Ottawa; no breeze/wind is recorded at this moment. **a)** What is the mode of heat transfer? **b)** What is the film temperature? **(10 marks)** The following properties have been found for air at the film temperature:

$$GrPr = 2.62 \times 10^{11}, \quad k = 0.02685 \text{ W/m.K}$$

Gr is Grashof number, Pr is Prandtl number and Nu is Nusselt number.

$$Nu = 0.10(GrPr)^{\frac{1}{3}}$$

$$Nu = \frac{hL_c}{k}, \quad Q = hA(T_s - T_\infty), \quad \text{characteristic length is the wall height in this problem}(L_c)$$

c) What is the total amount of heat dissipation **in KW** from the wall on that day if the wall has a 5m height and it is 20 meters wide?

(30 marks)

Question 1: Which of the followings are true about Tertiary Treatment? (6 marks)

- The tertiary treatment can remove 40-80% of the ecological organics and 50-60% of the suspended solids.
- This treatment process can help to eliminate 99 percent of the impurities from the sewage and provides water that is almost of the same quality as drinking water.
- Serves as “food” for the microorganisms in the receiving body during the treatment.

“Tertiary treatment is the advanced treatment process, following secondary treatment of waste water that produces high-quality water. Tertiary treatment includes removal of nutrients such as phosphorus and nitrogen and practically all suspended and organic matter from waste water.”

Question 2: Optical smoke detectors focus on what principle in order to detect the presence of a fire? (5 marks)

- Obscuring light
- Levels of Carbon Dioxide
- Ionization