

مصرح باستخدام جداول وخرائط ومعادلات ومحاضرات إنتقال الكتلة
تقرب الإجابة الى أقرب رقمين عشريين:

السؤال الأول: (33 marks)

a- How is the concentration of a commodity defined? How is the concentration gradient defined? How is the diffusion rate of a commodity related to the concentration gradient? (7 marks)

b- A gas mixture consists of 8 kmol of H₂ and 2 kmol of N₂. Determine the mass of each gas and the apparent gas constant of the mixture. (7 marks)

c- Consider two identical cups of coffee, one with no sugar and the other with plenty of sugar at the bottom. Initially, both cups are at the same temperature. If left unattended, which cup of coffee will cool faster? (7 marks)

d- One way of increasing heat transfer from the head on a hot summer day is to wet it. This is especially effective in windy weather, as you may have noticed. Approximating the head as a 30-cm-diameter sphere at 30°C with an emissivity of 0.95, determine the total rate of heat loss from the head at ambient air conditions of 1 atm, 25°C, 40 percent relative humidity, and 25 km/hr winds if the head is (a) dry and (b) wet. Take the surrounding temperature to be 25°C. The Sherwood number and the mass transfer coefficients may be determined from:

$$Sh = 2 + \left[0.4 Re^{1/2} + 0.06 Re^{2/3} \right] Sc^{0.4} \left(\frac{\mu_{\infty}}{\mu_s} \right)^{1/4} \quad (12 \text{ marks})$$

السؤال الثاني: (33 marks)

a- At a given temperature and pressure, do you think the mass diffusivity of air in water vapor will be equal to the mass diffusivity of water vapor in air? Explain. (7 marks)

b- What is the physical significance of the Sherwood number? How is it defined? To what dimensionless number does it correspond in heat transfer? What does a Sherwood number of 1 indicate for a plain fluid layer? (7 marks)

C- Dry air at 15°C and 92 kPa flows over a 2-m-long wet surface with a free stream velocity of 4 m/sec. Determine the average mass transfer coefficient. (7 marks)

d- Prove that:

$$h_{\text{heat}} (T_{\infty} - T_s) = \rho \cdot h_{\text{mass}} \cdot h_{\text{fg}} \cdot \frac{M_v}{M} \left(\frac{P_{v,s} - P_{v,\infty}}{P} \right) \quad (12 \text{ marks})$$

(34 marks) السؤال الثالث:

a- A gas mixture consists of 5 lbm of O₂, 8 lbm of N₂, and 10 lbm of CO₂. Determine (a) the mass fraction of each component, (b) the mole fraction of each component, and (c) the average molar mass of the mixture. (7 marks)

b- Does a mass transfer process have to involve heat Transfer ? Describe a process that involves both heat and mass transfer. (7 marks)

C- A 2-cm-diameter spherical naphthalene ball is suspended in a room at 1 atm and 80 °C. Determine the average mass transfer coefficient between the naphthalene and the air if air is forced to flow over naphthalene with a free stream velocity of 15 m/s. The Schmidt number of naphthalene in air at room temperature is 2.35. (8 marks)

d- A 2-m-deep 20-m x 20-m heated swimming pool is maintained at a constant temperature of 30°C at a location where the atmospheric pressure is 1 atm. If the ambient air is at 20°C and 60 percent relative humidity and the effective sky temperature is 0°C, determine the rate of heat loss from the top surface of the pool by (a) radiation, (b) natural convection, and (c) evaporation. (d) Assuming the heat losses to the ground to be negligible, determine the size of the heater (12 marks).