Me263 – Fluids and Heat Transfer

Finding ‘h’ and Transient Heat Transfer

Question 1

10-29 Consider a refrigeration truck traveling at 85 km/h at a location where the air temperature is 30°C. The refrigerated compartment of the truck can be considered to be a 2.6-m-wide, 2.4-m-high, and 7-m-long rectangular box. The refrigeration system of the truck can provide 3 tons of refrigeration (i.e., it can remove heat at a rate of 633 kJ/min). The outer surface of the truck is coated with a low-emissivity material, and thus radiation heat transfer is very small. Determine the average temperature of the outer surface of the refrigeration compartment of the truck if the refrigeration system is observed to be operating at half the capacity. Assume the air flow over the entire outer surface to be turbulent, and the heat transfer coefficient at the front and rear surfaces to be equal to that on side surfaces.

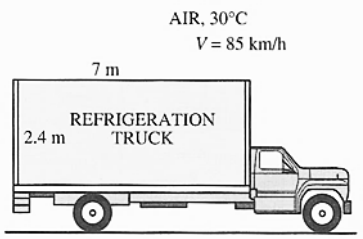

FIGURE P10-29

Question 2

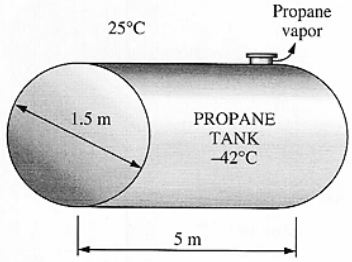

FIGURE P11-38

11-38 A 1.5-m-diameter, 5-m-long cylindrical propane tank is initially filled with liquid propane, whose density is 581 kg/m^3. The tank is exposed to the ambient air at 25°C in calm weather. The outer surface of the tank is polished so that the radiation heat transfer is negligible. Now a crack develops at the top of the tank, and the pressure inside drops to 1 atm while the temperature drops to −42°C which is the boiling temperature of propane at 1 atm. The heat of vaporization of propane at 1 atm is 425 kJ/kg. The propane is slowly vaporized as a result of the heat transfer from the ambient air into the tank, and the propane vapor escapes the tank at −42°C through the crack. Assuming the propane tank to be at about the same temperature as the propane inside at all times, determine how long it will take for the tank to empty if it is not insulated.

Question 3

Consider an aluminum cold drink can that is initially at a uniform temperature of 3°C. The can is 12.5 cm high and has a diameter or 6 cm. If the convection heat transfer coefficient between the can and the surrounding air at 25°C is 10 W/(m^2·°C), determine how long it will take for the average temperature of the drink to rise to 10°C.

In an effort to slow down the warming of the cold drink a person puts the can in a perfectly fitting 1 cm thick cylindrical rubber insulation [k = 0.13 W/(m·°C)]. Now how long will it take for the average temperature of the drink to rise to 10°C? Assume the top of the can is not covered.

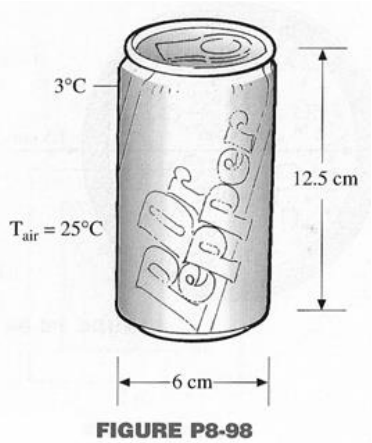

FIGURE P8-98