H.W. 1

Q1

Methanol Liquid is pumped from a big tank through a 1in. ID pipe at a rate of 6.00 gal/min. At what rate in (i) ft.ib$_f$/s and (ii) hp is kinetics energy being transported by the methanol in the pipe?

Q2

A 6-cm inner diameter of a piston-fitted cylinder contains 2 g of nitrogen was placed in 30°C and 1.00 atm. The mass of the piston is 4.50 kg, and a 20.00-kg weight rests on the piston.

(a) What is the absolute pressure of the gas in the cylinder and what is the volume occupied by the gas, assuming ideal gas behavior.

(b) Suppose the weight is abruptly lifted and the piston rises to a new equilibrium position. Further suppose that the process takes place in two steps: a rapid step in which a negligible amount of heat is exchanged with the surroundings, followed by a slow step in which the gas returns to 30°C. Considering the gas as the system, write the energy balances for step 1, step 2, and the overall process. In all cases, neglect *kinetic and potential energy.*

(c) The work done by the gas equals the restraining force (the weight of the piston plus the force due to atmospheric pressure) times the distance traveled by the piston. Calculate this quantity and use it to determine the heat transfer to or from the surrounding during the process.

Q3

Air at 250°C and 150 kPa flows through a horizontal 7-cm ID pipe at a velocity of 42.0 m/s.

(a) Calculate *the kinetics energy (W)*, assuming ideal gas behavior,

(b) If the air is heated to 400°C at constant pressure, what is $E_k = E_k(400°C) — E_k(250°C)$?

(c) Why would it be incorrect to say that the rate of transfer of heat to the gas in part (b) must equal the rate of change of kinetic energy?

Q4

Consider an automobile with a mass of 7000 lbm braking to a stop from a speed of 70 miles/h. (a) How much energy (Btu) is dissipated as heat by the friction of the braking process?