SEOUL NATIONAL UNIVERSITY
SCHOOL OF MECHANICAL AND AEROSPACE ENGINEERING

SYSTEM ANALYSIS **Spring 2015**

HW #8 **Assigned : May 12 (Tu)**
Due: May 21 (Th)

1. The oven shown in Figure 1 has a heating element with appreciable capacitance C_1. The other capacitance is that of the oven air C_2. The corresponding temperatures are T_1 and T_2, and the outside temperature is T_0. The thermal resistance of the heater-air interface is R_1; that of the oven wall is R_2. Develop a model for T_1 and T_2, with input q_i, the heat flow rate delivered to the heater mass.

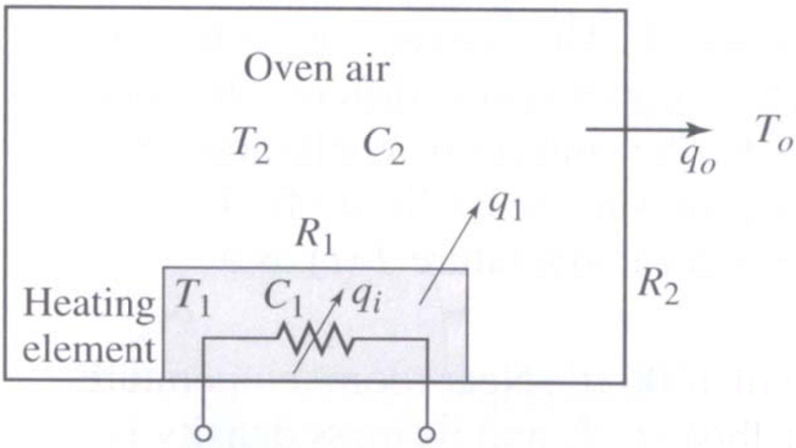

Figure 1

2. In figure 2 the piston of area A is connected to the axle of the cylinder of radius R, mass m, and inertia I about its center. Given $p_1 - p_2 = 3 \times 10^5$ Pa, $A = 0.005\text{m}^2$, $R = 0.4\text{m}$, $m = 100\text{kg}$, and $I = 7\text{kg}\cdot\text{m}^2$, determine the angular velocity $\omega(t)$ of the cylinder assuming that it starts from rest.

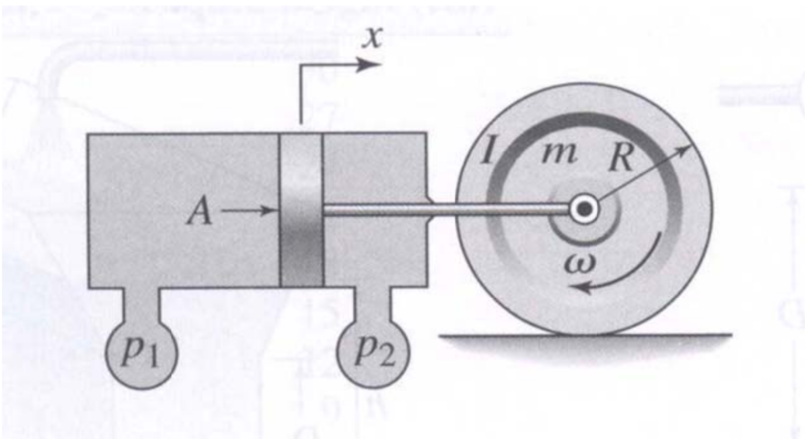

Figure 2

3. Design a piston –type damper using an oil with a viscosity at 20°C of μ = 0.9 kg/(m·s). The desired damping coefficient is 2000N·s/m. See Figure 3. (Assume laminar, incompressible and $m\ddot{y} \approx 0$)

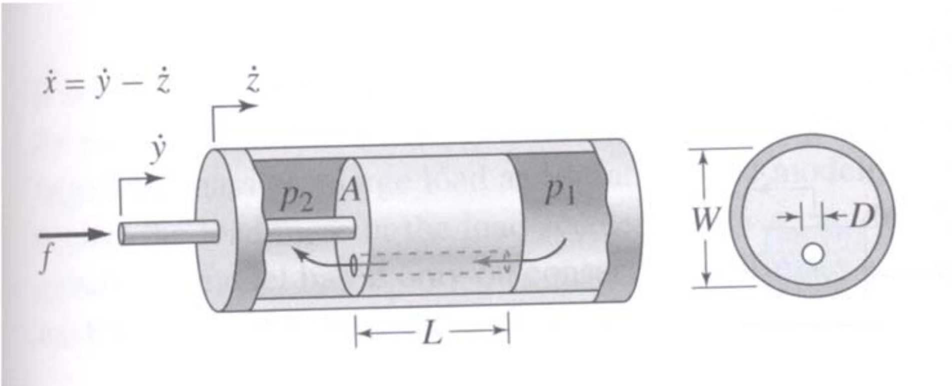

Figure 3

Hints:

$$m\ddot{y} = f - A(p_1 - p_2)$$

$$q_\upsilon = \frac{1}{\rho R}(p_1 - p_2)$$

$$q_\upsilon = A(\dot{y} - \dot{z})$$

$$R = \frac{128\mu L}{\pi\rho D^4}$$