Name _____ Section _____

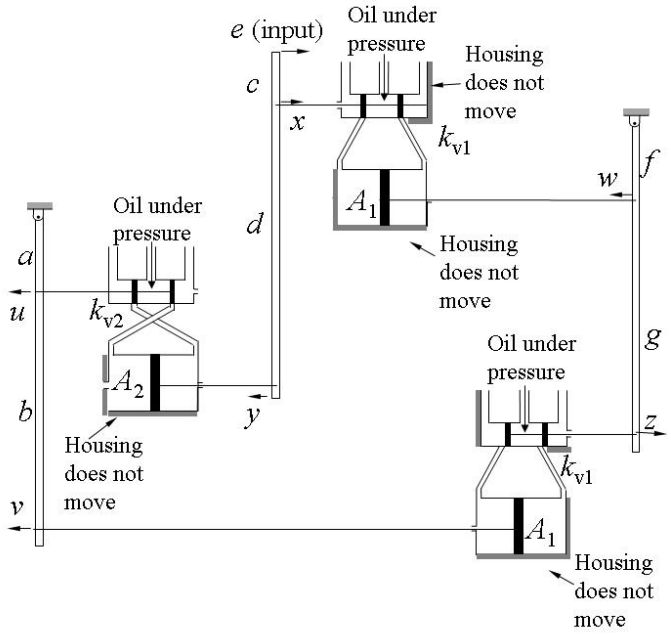
ES205
Examination II
May 4, 2006

Problem	Score
1	/25
2	/25
3	/30
4	/20
Total	/100

Show all work for credit
AND
Turn in your signed help sheet
AND
Stay in your seat until the class ends
(Translation: I am not going to let you leave early,
so you might as well check your answers!)

ES205 Examination II **Problem 1** May 4, 2006

The three hydraulic cylinders are connected in series as shown. The lever segment lengths are given as *a, b, c, d, f,* and *g* respectively. Given input *e*, find the equations necessary to determine the transfer function from *e* to *y*.



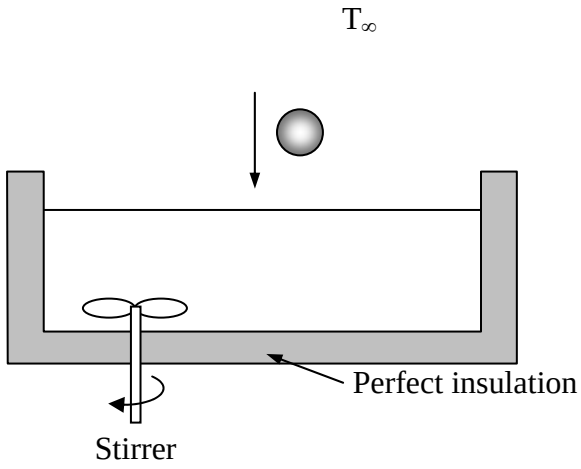
25 pts

ES205 Examination II **Problem 2** May 4, 2006

A very hot small steel sphere of mass, m_s, surface area, A_s, and specific heat, c_s, has an intial temperature T_{s_0} when it is dropped into a small water bath of initial temperature $T_{w_0} = T_\infty$ where T_∞ is the temperature of the surrounding air. The surface area of the water is A_w. The mass of the water in the bath is, m_w, and its specific heat is c_w and the water is being continually stirred. The convective heat transfer coefficient between the sphere and the water is h_1 and between the water and the air is h_2.

Neglecting radiation determine

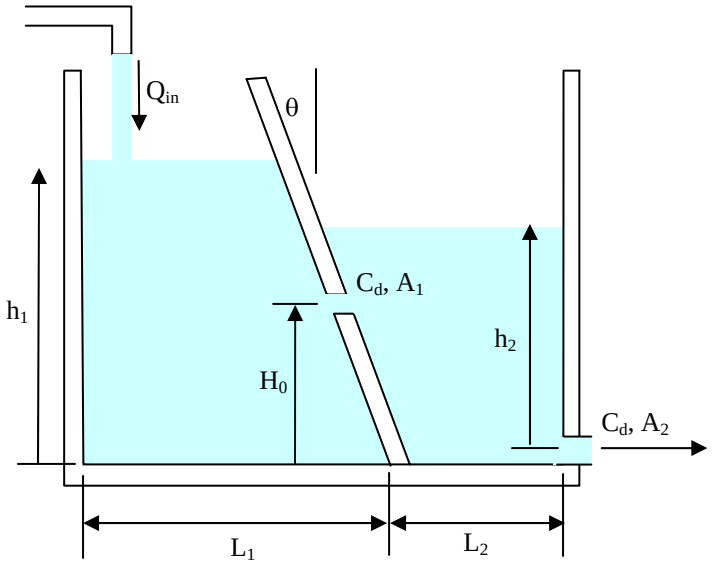
a) the equations governing the temperature of the sphere and the temperature of the water
b) the steady state temperature of the sphere and the water



30 pts

ES205 Examination II **Problem 3** May 4, 2006

The tank shown has a depth, w, into the paper. The tank is divided into two chambers as shown below. Determine the equations of motion govering the height of fluid in the two chambers of the tank, that is, h_1 and h_2 assuming the inflow, Q_{in} is known.



20 pts

ES205 Examination II **Problem 4** May 4, 2006

A system is found to be governed by the following differential equation:

$$a^2\ddot{x} + ab\dot{x} + x = f(t)$$

The required performance specifications for a system are:

- Percent overshoot: less than 25% (which means $\zeta > 0.4037$)
- 2% settling time: less than 8 seconds
- $a < 1$

Sketch these constraints in the a-b design space on the axis provided.