Name _____ Section _____

ES205
Examination II
April 24, 1998

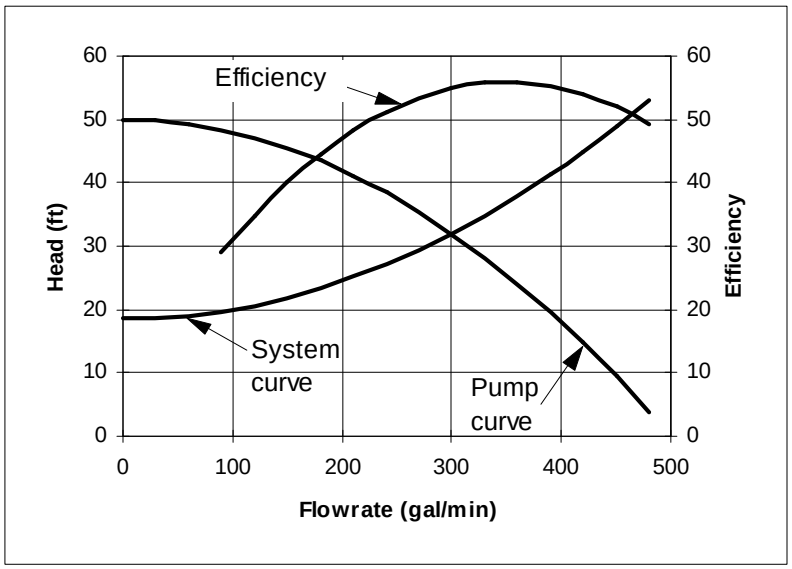
Problem	Score
1	/20
2	/25
3	/25
4	/30
Total	/100

Show all work for credit
AND
Turn in your signed help sheet

Name _____ 25 pts

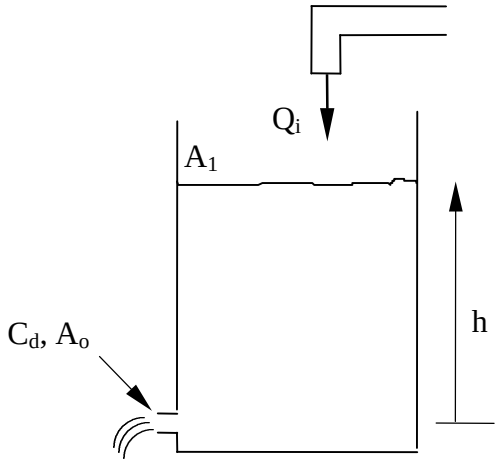
ES205 Examination II **Problem 1** April 24, 1998

1a) For the system curve and the pump curve shown below determine the operational flow rate and efficiency of the pump.

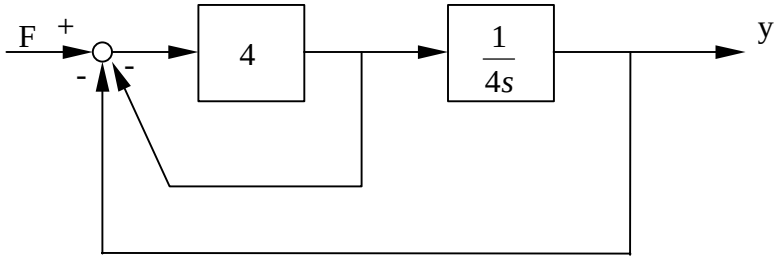


1b) Assuming a pump has an efficiency of 70% and supplies a head of 100 ft with a mass flow of 10 slug/s determine the power required by the pump in ft-lbf/s.

1c) The tank shown below is initially empty when water is poured in at a constant rate Q_i. Determine the steady state height of fluid in the tank.



1d) What differential equation is modeled by the block diagram shown below. The input is F and the output is y.



Name _____ 25 pts

ES205 Examination II **Problem 2** April 24, 1998

An electronic circuit chip that is 6 mm square and 1.5 mm thick is mounted to the surface of a plastic substrate. The exposed top surface is convectively cooled by a large volume of dielectric liquid for which h = 150 W/(m^2-K). The temperature of the liquid is 25°C. Prior to the chip being energized it is in thermal equilibrium with the coolant ($T_{chip}=T_{liquid}$). After the chip is energized its temperature increases until a new steady state is established. The energized chip draws 0.20 W of power. Assume an infinite contact resistance between the chip and substrate and negligible conduction resistance within the chip determine:

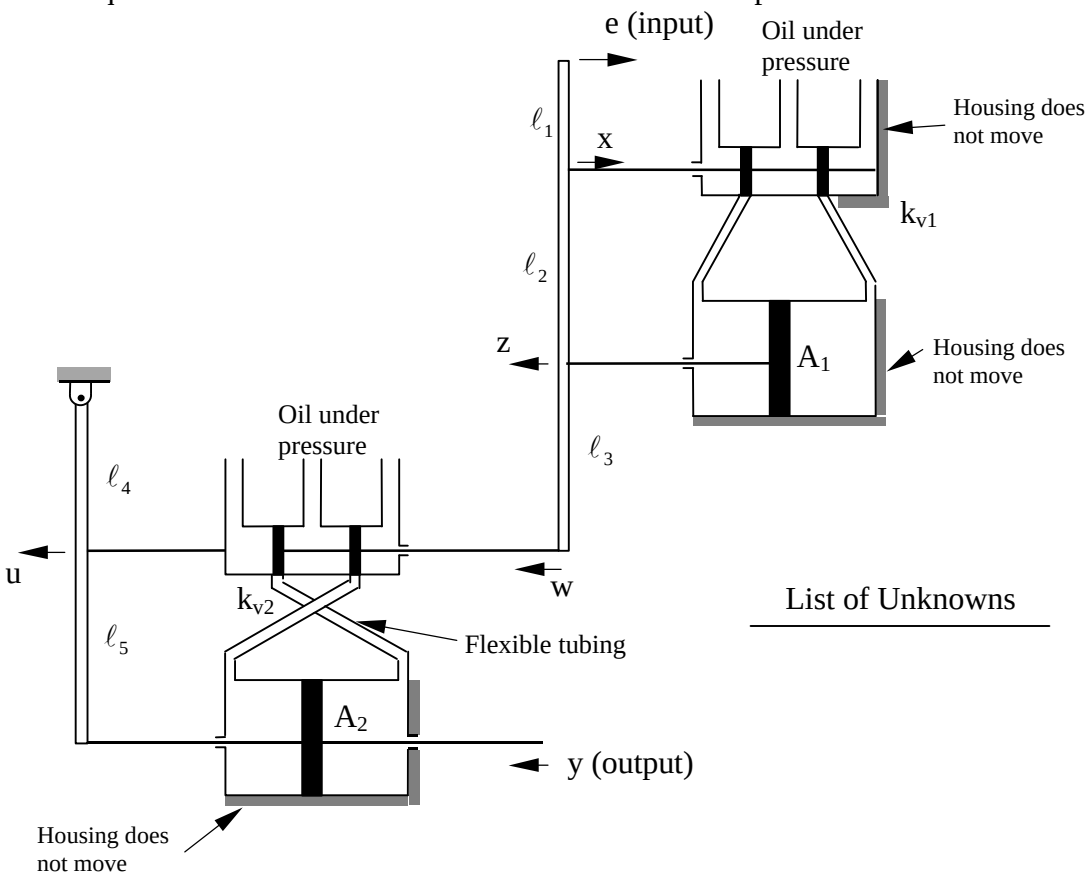
a) The final steady state temperature of the energized chip
b) The time required for the chip to come within 1°C of the final steady state temperature.

Note: The mass and specific heat of the chip are m = 10^{-4} kg and c_p= 700 J/(kg - K) respectively

Name _____ 25 pts

ES205 Examination II **Problem 3** April 24, 1998

Determine a set of equations that could be used to determine the EOM relating the input e to the output y for the hydraulic servo system.. DO NOT SOLVE THESE EQUATIONS! You solution should consist of numbered equations and a list of unknowns. Assume small displacements.



List of Unknowns

Name _____ 30 pts

ES205 Examination II **Problem 4** April 24, 1998

For showers, a Boy Scout camp uses a tank of water as shown below. Assume the length of pipe is 25 feet long with an inside diameter of 0.5 in. Assume the pipe is copper ($\varepsilon = 0.000005$ ft), the 90° elbows have a loss coefficient equal to $K_{90°} = 2.0$ and the entrance has a loss coefficient equal to $K_{ent} = 1.0$. The kinematic viscosity of the water is $\nu = 0.739 \times 10^{-5}$ ft^2/s.

a) If when a camper starts to take a shower the initial velocity of water coming out the shower head is 3 ft/s determine the height of water above the pipe discharge at this instant.
b) Assuming the area of the tank is 30 ft^2, what would the water level be at the end of a 30 minute shower? Assume the friction factor is constant and equal to the value you obtained in part a). Note: The velocity coming out of the shower head is not constant.