

Name _____ Section _____

ES205
Examination II
May 5, 2005

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

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

1.1-1.3) A second order underdamped system is subjected to a step input with zero initial conditions. After putting the equation of motion in standard form you find:

$$\omega_n = \sqrt{\frac{k}{m}} \quad \text{and} \quad \zeta = \frac{c}{2k} \omega_n = \frac{c}{2\sqrt{km}}$$

1.1 In what ways can you **reduce** the percent overshoot of the system? Circle one answer for each parameter. (2pts)

- | | | | |
|------------------|----------|----------|-----------|
| a) Stiffness, k: | Increase | Decrease | No effect |
| b) Damping, c: | Increase | Decrease | No effect |
| c) Mass, m: | Increase | Decrease | No effect |

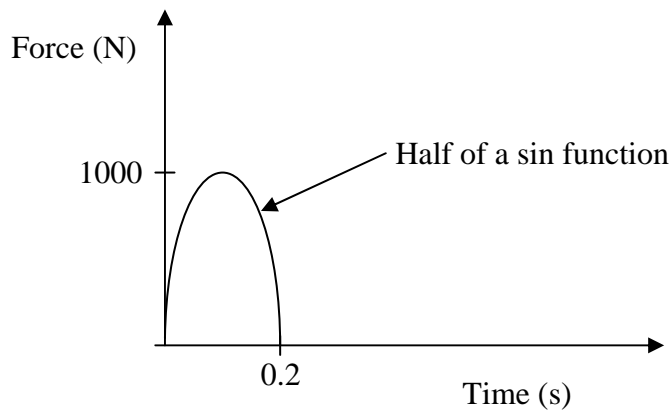
1.2 In what ways can you **decrease** the settling time? Circle all the correct answers. (3 pts)

- | | | | |
|------------------|----------|----------|-----------|
| a) Stiffness, k: | Increase | Decrease | No effect |
| b) Damping, c: | Increase | Decrease | No effect |
| c) Mass, m: | Increase | Decrease | No effect |

1.3 In what ways can you **decrease** the time to the first peak? Circle all the correct answers. (3 pts)

- Increase the damping ratio
- Decrease the damping ratio
- Increase the natural frequency
- Decrease the natural frequency
- Increase the damped natural frequency
- Decrease the damped natural frequency

1.4 The following input is needed for a Simulink block diagram. Briefly discuss how you would create this input. (4 pts)



1.5) The response of a first order system was measured in the log-incomplete response was obtained and plotted as shown in Figure 1. Determine the time constant of the system. (4 pts)

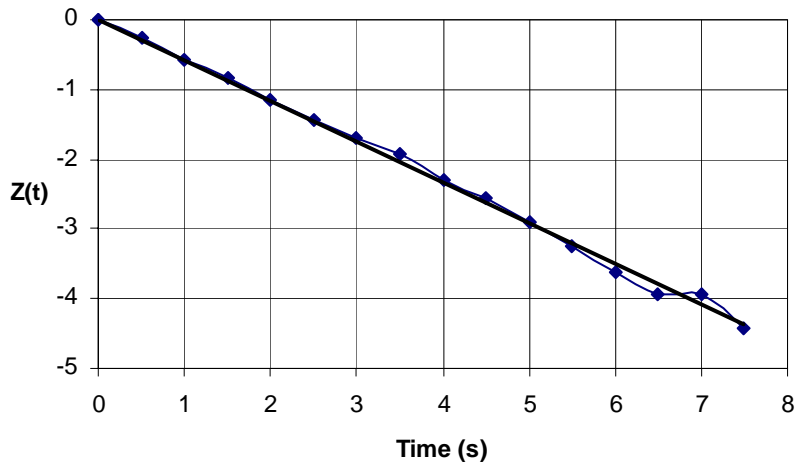
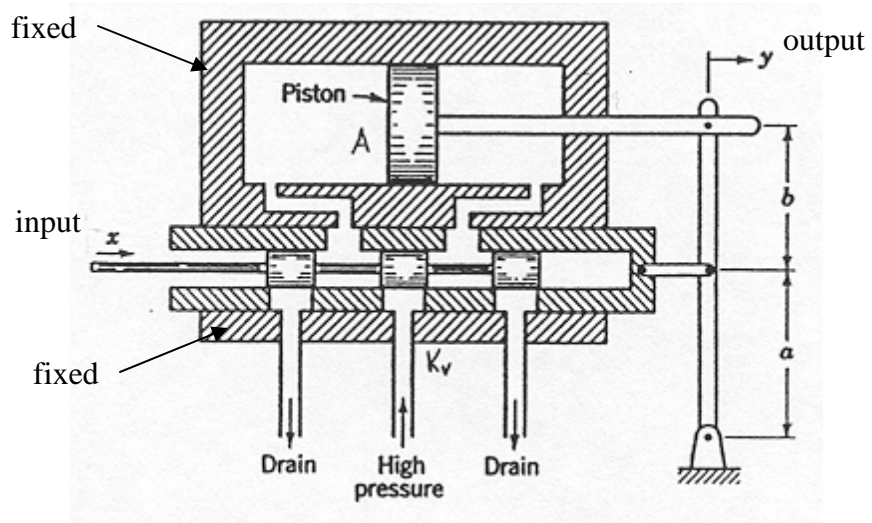


Figure 1: Log incomplete response with a least squares fit

1.6 What does “lumped capacitance mean in heat transfer problems? How can you tell if you may make the lumped capacitance assumption? (4 pts)

Determine

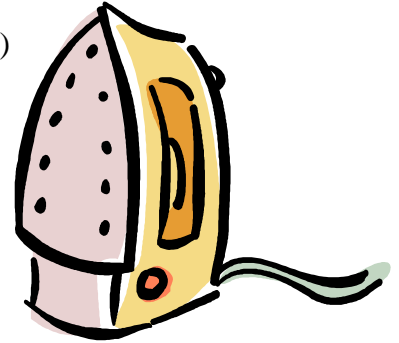
- the time constant for the hydraulic system shown below. Assume small displacements, K_v = valve constant, A = area of the piston. (15 pts)
- What parameters would you change to make the response of this system faster? (5 pts)



Consider a 1000-W iron whose base plate is made of aluminum ($c_p = 875 \text{ J}/(\text{kg}\cdot^\circ\text{C})$). The area of the base plate is 0.03 m^2 , and its mass is 0.416 kg . Initially the iron is at the same temperature of the room, 22°C . The heat transfer coefficient of the base plate is $12 \text{ W}/(\text{m}^2\cdot^\circ\text{C})$. Assume that 85% of the heat generated in the resistance wires is transferred to the plate. Determine:

- A differential equation for the temperature of the base plate
- How long will it take for the plate temperature to reach 140°C ?

$$h = 12 \text{ W}/(\text{m}^2\cdot^\circ\text{C})$$
$$T_\infty = 22^\circ\text{C}$$



1000 W iron

The tank shown has a depth, w , into the paper. Determine the equation of motion governing the height of fluid in the tank assuming

- The valve at B is open and P_0 is atmospheric pressure. (25 pts)
- Discuss how your equation would change if the air above the fluid is pressurized to a relatively high gage pressure, P_0 . After the the tank begins to drain assume no additional air enters the tank. What other information would you need to be given? (5 pts)

