Name _____ Section _____

ME 422

Quiz 1

4 October 2010

Answer the problems below showing all work. A correct answer is insufficient for full credit. It must also be clear how you arrived at your answer.

1. A control loop has a P-only controller with a gain of K, an actuator with a gain of 1/K, and a first-order plant with $K/(T \cdot s + 1)$. The sensor is slow so is also modeled as a first-order system with $(K/4)/[(T/8) \cdot s + 1]$.

   a. Draw the control loop of this system.

   b. What is the open-loop transfer function of the control loop?

   c. What is the open-loop gain?

   d. What is the closed-loop transfer function of the control loop?

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e. Give the closed-loop system's K_{ss}, ζ, and ω_n in terms of K and T. Show your work. (For a unit step input, K_{ss} is what is left after all the s's go to 0.)

f. Under what conditions would this system oscillate when given a step input? Make your reasoning and analysis clear.