

## Explanations (Part b, e, f)

b.) It's important to linearize non-linear systems when we are trying to model them because linear systems are well studied and easier to model. Linearization works well because most non-linear dynamical systems are linear for a short duration.

e.) If the dampening coefficient is increased the oscillations of the pendulum approach the stable point faster.

If there was friction on the motor, the equation would change. The friction coefficient would be in the  $u$  matrix as a dampening coefficient, as the  $u$  is the torque for the motor.

f.) When  $Q$ 's diagonal values are increased then the difference between the system state and the fixed point state is increased, as seen in the equation 1 part  $Q(x-x^*)$ . This makes the changes in the system more dramatic and sharp. In the graph for angular velocity, one can observe a change in the initial part of the graph, albeit very minimal. The dip is sharper and the rise is more dramatic when  $Q$  has larger diagonal values.