ENGR 2340 Dynamics
Poles and step response

For the mass-spring-damper system subject to a step input,

$$\ddot{x}(t) + 2\zeta\omega_n \dot{x}(t) + \omega_n^2 x(t) = F_0 \quad \text{with IC's} \quad x(0) = 0 \ \text{ and } \ \dot{x}(0) = 0$$

Sketch the location of the (two) poles of the system on the s-plane and the step response when the system is a) undamped, b) underdamped, c) critically damped, d) overdamped, and e) ‘negatively’ damped (*i.e.*, $\zeta\omega_n < 0$).