Math 207 Mass-Spring Systems

1. Consider the mass-spring system governed by the initial boundary problem

$$y'' + 4y' + 13y = 0 \ , \ y(0) = 1, \ y'(0) = 1$$

a. Solve the above initial boundary problem to express the displacement of the mass from equilibrium as a function of time.
b. Write your solution in the form $y = Ae^{kt}\sin(\omega t + \phi)$.
c. When is the mass furthest from its equilibrium position?
d. What would happen to the quasi-period if the damping coefficient were decreased?

2. Consider the mass-spring system governed by the initial boundary problem

$$y'' + 4y' + 3y = 0 \ , \ y(0) = 1, \ y'(0) = -v_0$$

where $v_0 > 0$ (so that we stretch the spring beyond its equilibrium position and give the mass an initial velocity toward equilibrium).
a. Show that this mass-spring system does not oscillate about equilibrium.
b. Find the minimum value of v_0 that ensures the mass passes the equilibrium position once or show that such a value of v_0 does not exist.

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