Show your work!

(1) The solution curves for the second-order differential equation

$$m\ddot{x} = -kx$$

look like ellipses in the (x, v)-plane, where $v = \dot{x}$.

   (a) Re-write this second-order equation as a system of first-order equations in x and v.

   (b) What is the equation of an ellipse in the (x, v)-plane? Your answer should look like

$$\boxed{\text{something}} = C,$$

where $\boxed{\text{something}}$ is a formula involving x and v, and C is a constant.

   (c) Prove that the solution curves are ellipses by computing $\dfrac{d}{dt}\boxed{\text{something}}$. (HINT: What answer should you get for the derivative? Use the system of first-order equations to re-write $\dfrac{d}{dt}\boxed{\text{something}}$ in terms of x and v only.)

(2) **Five** book problems: #2.2.10, 11, 19, 26, 27.