Problem 1. Consider the system of coupled differential equations

$$2\ddot{x} + \ddot{y} + 3x = 0,$$
$$\ddot{x} + \ddot{y} + 2y = 0.$$

(a) Write the system in matrix form

$$M\ddot{\mathbf{q}} + K\mathbf{q} = 0, \quad \text{where } \mathbf{q} = \begin{pmatrix} x \\ y \end{pmatrix}.$$

(b) Determine the normal frequencies of the system.
(c) Find the corresponding normal modes (eigenvectors).
(d) Write the general solution in terms of normal coordinates.