(1) Suppose an $n \times n$ real matrix A has a complex eigenvalue $\lambda = \alpha + i\beta$. Let v be an eigenvector for λ. Write v as $v = u + iw$ where both u and w are real vectors.
   (a) Show that $\bar{v} = u - iw$ is also an eigenvector of A.
   (b) Prove that u, w are linearly independent.
   (c) If A is 2×2 show that it's similar to its "canonical form" $\begin{pmatrix} \alpha & \beta \\ -\beta & \alpha \end{pmatrix}$

(2) Let $A = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$ be a 2×2 real matrix with complex eigenvalues.
   (a) Prove that $bc < 0$.
   (b) In terms of a, b, c, d determine if A produces clockwise or counterclockwise spirals when plotting solutions of $y' = Ay$.
   (The answer will depend on the sign of a certain expression in a, b, c, d).

(3) Let A be a real $n \times n$ matrix. For a real t and positive δ, let t_n be a sequence of numbers in $[t - \delta, t + \delta]$.
   Let $E_\delta = \sum_{n=0}^{\infty} \frac{t_n^n A^n}{n!}$.
   Show that $E_\delta \to e^{tA}$ as $\delta \to 0$.