Books, watches, notes or cell phones are **not** allowed. The **only** calculators allowed are the Sharp EL-531**. You **must** show all your work, the correct answer is worth 1 mark the remaining marks are given for the work.

Question 1. *(5 marks)* Prove that if $\{\vec{v}1, \vec{v}_2\}$ is linearly independent and $\vec{v}_3$ does not lie in span$\{\vec{v}_1, \vec{v}_2\}$, then $\{\vec{v}_1, \vec{v}_2, \vec{v}_3\}$ is linearly independent.

Question 2. Consider the subspace $H = \left\{ A \,\middle|\, A \in \mathscr{M}_{2\times 2} \text{ and } \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix} A = A \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix} \right\}$.

a. *(1 marks)* Is $\mathbf{0}$ (the 2×2 zero matrix) in H?

b. *(1 marks)* Is I (the 2×2 identity matrix) in H?

c. *(1 mark)* For what a is $\begin{bmatrix} 2 & 2 \\ 3 & a \end{bmatrix}$ in H?

d. *(4 marks)* Find a basis for H.

e. *(2 marks)* Express the matrix you found in part c. relative to the basis found in part d., if possible.