1. Let

$$A = \begin{pmatrix} 1 & -3 & -5 \\ 1 & 1 & -2 \\ 1 & -3 & 1 \\ 1 & 1 & 4 \end{pmatrix}, \qquad \vec{b} = \begin{pmatrix} -6 \\ 1 \\ 1 \\ 6 \end{pmatrix}.$$

If the Gram-Schmidt process is applied to determine an orthonormal basis for $C(A)$ and a QR factorization of A, then, after the first two orthonormal vectors $\vec{q}_1$ and $\vec{q}_2$ are computed, we have

$$Q = \begin{pmatrix} \frac{1}{2} & -\frac{1}{2} & \_\_ \\ \frac{1}{2} & \frac{1}{2} & \_\_ \\ \frac{1}{2} & -\frac{1}{2} & \_\_ \\ \frac{1}{2} & \frac{1}{2} & \_\_ \end{pmatrix}, \qquad R = \begin{pmatrix} 2 & -2 & \_\_ \\ 0 & 4 & \_\_ \\ 0 & 0 & \_\_ \end{pmatrix}.$$

(a) Finish the process. Determine $\vec{q}_3$ and fill in the third columns of Q and R. *[6 points]*

(b) Use the QR factorization to find the least squares solution of $A\vec{x} = \vec{b}$. *[4 points]*