1. Answer the following questions about $A \in \mathbb{R}^{3\times 3}$ below.

$$A = \begin{pmatrix} 1 & 0 & 2 \\ 0 & -1 & -2 \\ 2 & -2 & 0 \end{pmatrix}.$$

(a) Is A positive definite? Justify your answer. *[2 points]*

(b) Calculate the sum of the eigenvalues of A. Show your work! *[2 points]*

(c) Calculate the product of the eigenvalues of A. Show your work! *[3 points]*

(d) The matrix A can be diagonalized as $A = Q\Lambda Q^{\mathrm{T}}$. Fill in the blanks below: *[3 points]*

$$A = \begin{pmatrix} -\frac{1}{3} & \_\_\_\_ & -\frac{2}{3} \\ \frac{2}{3} & \_\_\_\_ & \frac{1}{3} \\ \frac{2}{3} & \_\_\_\_ & -\frac{2}{3} \end{pmatrix} \begin{pmatrix} -3 & 0 & 0 \\ 0 & \_\_\_\_ & 0 \\ 0 & 0 & 3 \end{pmatrix} \begin{pmatrix} \_\_\_\_ & \_\_\_\_ & \_\_\_\_ \\ \_\_\_\_ & \_\_\_\_ & \_\_\_\_ \\ \_\_\_\_ & \_\_\_\_ & \_\_\_\_ \end{pmatrix}.$$