The components of strain at a point are given by

$$[\varepsilon_{ij}] = 10^{-4}\begin{bmatrix} 1 & -3 & \sqrt{2} \\ -3 & 1 & -\sqrt{2} \\ \sqrt{2} & -\sqrt{2} & 4 \end{bmatrix}.$$

The vectors $\mathbf{m}$ and $\mathbf{n}$ are defined by $\mathbf{m} = -\mathbf{e}_1 + \mathbf{e}_2 + \sqrt{2}\mathbf{e}_3$ and $\mathbf{n} = \mathbf{e}_1 - \mathbf{e}_2 + \sqrt{2}\mathbf{e}_3$.
(a) Determine the normal strain in the direction of the vector $\mathbf{n}$.
(b) Determine the shear strain in the direction of $\mathbf{m}$ on the plane with a normal $\mathbf{n}$.
(c) Determine the principal strains.
(d) Determine the principal strain directions.

The transformation rule for changing strain components under rotation of axes is
$\varepsilon^*_{ij} = Q_{ip}Q_{jq}\varepsilon_{pq} = \sum_{p=1}^{3}\sum_{q=1}^{3} Q_{ip}Q_{jq}\varepsilon_{pq}$ where $Q_{ij} = \mathbf{e}^*_i \bullet \mathbf{e}_j$ and $\mathbf{e}^*_i, \mathbf{e}_j$ are base vectors.