1. (a) $\det(A^{-1}) = 1/\det(A) = 1/3$.
   (b) A has full rank since it is nonsingular. Thus $\operatorname{rank} A = 3$.
   (c) not enough information
   (d) $\det(A^T B) = \det(A^T)\det(B) = \det(A)\det(B) = 6$.

2. Since $\det(A - \lambda I) = \lambda^2 - \lambda - 2 = (\lambda - 2)(\lambda + 1)$, the eigenvalues are 2 and -1.

3. Recall that $[T]_{\mathcal{B}} = \big[[\mathbf{b}_1]_{\mathcal{B}}\ [\mathbf{b}_2]_{\mathcal{B}}\big]$. Since $T(\mathbf{b}_1) = \begin{bmatrix} 0 \\ 1 \end{bmatrix} = \mathbf{b}_2$ and $T(\mathbf{b}_2) = \begin{bmatrix} 1 \\ 0 \end{bmatrix} = -\mathbf{b}_1 + \mathbf{b}_2$, we have $[T]_{\mathcal{B}} = \begin{bmatrix} 0 & -1 \\ 1 & 1 \end{bmatrix}$.

4. (a) Since the dimension of an eigenspace cannot exceed the multiplicity of a root of the characteristic polynomial, it is at most 3. Thus the possible values are 1, 2 and 3.
   (b) No. The sum of the dimensions of the eigenspaces is at most $2+2+3=7$, which is less than 8, the size of A.
   (c) It must be singular since zero is an eigenvalue.
   (d) The only possible values are the eigenvalues, namely 0, 1 and -2.