1. The rank of a matrix equals the maximum number of linearly independent columns
   Ans b
2. Given the matrix $\mathbf{X} = \begin{bmatrix} 1 & 2 & 1 \\ 2 & 4 & 5 \\ 3 & 6 & 1 \end{bmatrix}$. As shown in the lectures, its rank can be found by Gaussian elimination and equals 2
   Ans c
3. The Cauchy-Schwarz inequality for inner products states that $|\langle \bar{\mathbf{u}}, \bar{\mathbf{v}} \rangle| \leq \|\bar{\mathbf{u}}\| \|\bar{\mathbf{v}}\|$
   Ans d
4. The row reduced echelon form is obtained as follows
$$\begin{bmatrix} 1 & 1 & 1 \\ 2 & 1 & 3 \\ 4 & 1 & 5 \end{bmatrix} \rightarrow \begin{bmatrix} 1 & 1 & 1 \\ 0 & -1 & 1 \\ 0 & -3 & 1 \end{bmatrix} \rightarrow \begin{bmatrix} 1 & 1 & 1 \\ 0 & -1 & 1 \\ 0 & 0 & -2 \end{bmatrix}$$
   Ans d

5. The multivariate distribution for n jointly Gaussian random variables $x_1, x_2, \ldots, x_n$, with mean 0 and variance σ^2 is given as
$$\left(\frac{1}{2\pi\sigma^2}\right)^{\frac{N}{2}} e^{-\frac{\|\bar{\mathbf{x}}\|^2}{2\sigma^2}}$$
   Ans a
6. Given the vectors $\bar{\mathbf{w}}_1 = [1 \quad 1 \quad 1]^T$ and $\bar{\mathbf{w}}_2 = [1 \quad 2 \quad 3]^T$. These are Linearly independent
   Ans b
7. Null space of a matrix $\mathbf{A}$ comprises of all vectors $\bar{\mathbf{x}}$ such that $\mathbf{A}\bar{\mathbf{x}} = \bar{\mathbf{0}}$.
   Ans d
8. Orthonormal set of vectors $\{\bar{\mathbf{v}}_1, \bar{\mathbf{v}}_2, \ldots, \bar{\mathbf{v}}_n\}$ satisfy $\bar{\mathbf{v}}_i^T \bar{\mathbf{v}}_j = \mathbf{0}$ for all $i \neq j$ and $\left\|\bar{\mathbf{v}}_j\right\|^2 = 1$ for all j
   Ans c
9. Given the matrix $\mathbf{A} = \begin{bmatrix} 1 & 0 \\ 0 & 0 \end{bmatrix}$. One of its eigenvectors is $[1 \quad 0]^T$ since it satisfies the property $\mathbf{A}\bar{\mathbf{x}} = \bar{\mathbf{x}}$.
   Ans d
10. The quantity $\mathrm{Tr}\{\bar{\mathbf{x}}\bar{\mathbf{x}}^H \mathbf{A}\}$, where $\bar{\mathbf{x}}$ is an eigenvector of $\mathbf{A}$ corresponding to eigenvalue λ, can be simplified as
$$\mathrm{Tr}\{\bar{\mathbf{x}}\bar{\mathbf{x}}^H \mathbf{A}\} = \mathrm{Tr}\{\bar{\mathbf{x}}^H \mathbf{A}\bar{\mathbf{x}}\} = \mathrm{Tr}\{\bar{\mathbf{x}}^H \lambda \bar{\mathbf{x}}\} = \lambda \|\bar{\mathbf{x}}\|^2$$
    Ans c