1. (10%) Compute the product ABC of the following three matrices

$$A = \begin{bmatrix} 1 & 2 \\ 3 & -1 \end{bmatrix}, \ B = \begin{bmatrix} 0 & 1 & 3 \\ -1 & 0 & -2 \end{bmatrix}, \ \text{and } C = \begin{bmatrix} 4 \\ -1 \\ 0 \end{bmatrix}.$$

2. (10%) Simplify the following matrix expression

$$A(A+2B)+3B(2A-B)-A^2+7B^2-5AB$$

3. (20%) The set of solutions to a homogeneous system of linear equations is closed under addition and under scalar multiplication. It is a subspace.

4. (20%) Let A and B be matrices and c be a scalar.
   1. $(A+B)^t = \underline{\hspace{2cm}}$ *Transpose of a sum*
   2. $(cA)^t = \underline{\hspace{1.5cm}}$ *Transpose of a scalar multiple*
   3. $(AB)^t = \underline{\hspace{1.5cm}}$ *Transpose of a product*
   4. $(A^t)^t = \underline{\hspace{1.5cm}}$

5. (20%) Let A and B be symmetric matrices of the same size. Let C be a linear combination of A and B. Prove that C is symmetric.

6. (20%) Let A and B be symmetric matrices of the same size. Prove that the product AB is symmetric if and only if $AB = BA$.