1A. What is the general formula for the inverse of the 2×2 matrix $\begin{bmatrix} a & b \\ c & d \end{bmatrix}$; under what condition(s) does it exist?

1B. Let $M = \begin{bmatrix} 5 & 6 \\ 3 & 4 \end{bmatrix}$. Find the inverse M^{-1} of M. Write the answer in the form $\begin{bmatrix} q & r \\ s & t \end{bmatrix}$ (some of the entries might be fractions).

2. Suppose $A = \begin{bmatrix} p & 5 & 1 \\ 3 & w & 0 \\ 7 & 6 & 3 \\ 1 & 4 & 10 \end{bmatrix}$, $B = \begin{bmatrix} 10 & 8 & 5 \\ k & 4 & 9 \\ 3 & 7 & 2 \end{bmatrix}$, and their product AB is $C = \begin{bmatrix} 88 & a & 77 \\ c & v & 33 \\ 109 & g & 95 \\ f & 94 & u \end{bmatrix}$.

Find g, w, p, k. (For each of those unknowns g, w, p, k you should be able to find an equation involving just that one unknown; no systems required!)

3. What is the transpose of the matrix B from problem 2?

4. Let A be as in problem 2; you do not need to know the actual entries to answer this question.

4a) You can compute the product $A\,A^T$ (the dimensions are right). What are the dimensions of the resulting product, and how many individual pairs of numbers will need to be multiplied in order to compute $A\,A^T$?

4b) Similarly, the numbers of rows and columns are right to make it possible to find $A^T\,A$. What is the size of this matrix, and again, how many individual pairs of numbers will need to be multiplied in order to compute $A^T\,A$?